THE DEMAND FOR FOOD STAPLES IN UGANDA

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A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL OF THE
UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

2000

I dedicate this work to my sister, Grace.

ACKNOWLEDGMENTS

There are many people that have been of great help to me in the preparation of this dissertation. I run the risk of inadvertently omitting some deserving individuals, and if so, I, sincerely, apologize. First, I would like to thank my chairman, Dr. Thomas Spreen for his unwavering support throughout the course of my program and insightful comments in preparation of this document. I would like to acknowledge Dr. Robert Emerson's indispensable help in the interpretation and adaptation of Deaton's analytical demand model that is central to this dissertation. Many thanks also go to Dr. James Seale, Dr. Max Langham and Dr. William Bomberger for their helpful comments and encouragement along the way.

The Agricultural Economics Support Services group, especially Roger Clemmons, Alex Heyman and Carlos Jauregui were of tremendous help to me at various stages of my dissertation research. Thanks also goes to numerous individuals of the FRED support staff for facilitating the many behind the scenes processes I have had to go through in the course of my program.

All this could not have materialized without funding support from the Rockefeller Foundation, the Margoes Foundation and the Department of Food and Resource Economics at the University of Florida. To each, I am most grateful.

My dissertation research, funded by the Rockefeller Foundation, took me to Uganda where I interacted with a number of organizations and individuals who were very helpful to me. Many thanks go to staff members of Namulonge Research Institute, the Uganda National Council of Science and Technology, the Department of Statistics in the Ministry of Finance and Economic Development, the Makerere University Faculty of Agriculture and the district agricultural offices of Kumi and Pallisa. Special thanks go to my household survey teams in Kumi and Pallisa.

My father, has been my main inspiration throughout the course of my studies. I am very grateful to him for the encouragement, guidance and words of wisdom he has always afforded me and for laying a strong and enviable foundation for the family. Special thanks also go to the rest of my family in Uganda and Canada for their unerring love and for believing in me.

The fact that I have had to apportion my time between Gainesville, Florida and my family in North Carolina put considerable strain on my family and me. I could never have done without the unconditional support and love of my wife, Dr. Olivia Mijumbi and my two sons Richard and Raymond during these very trying times.

A word of thanks to the many fellow FRE graduate students I have interacted with over the years and who in various ways have made my stay here instructive and enjoyable. I also extend many thanks to the friendship extended to me by other faculty and students at the University of Florida. I feel my academic, cultural, and personal experiences have been enriched by all these interactions.

Special thanks go to the Uganda Community in Gainesville many of whom helped me in various ways that enabled me to complete my study program successfully. I cannot forget the special friendship of Dr. Edward Bresnyan and his family who have been like family to me. I also wish to thank Dr. Daniel Ottemoeller and Dr. Kimberley Lanegran for being such wonderful and supportive family friends.

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Abstract of Dissertation Presented to the Graduate School
Of the University of Florida in Partial Fulfillment of the
Requirements for the Degree of Doctor of Philosophy

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August 2000

Chairman: Dr. Thomas H. Spreen
Major Department: Food and Resource Economics

Knowledge of household food consumption patterns and how they respond with respect to changes in household incomes and food prices has long been recognized as a major input into economic planning and policy analysis in developing countries. Food production is the most widespread economic activity in Uganda; however, empirical research on household food consumption in Uganda has been limited in scope.

This dissertation uses cross-sectional data collected in the Uganda National Integrated Household Survey (IHS) to estimate demand elasticities of food staples in each of Uganda's four regions using Deaton's analytical demand model. Choice of this model was based on its ingenious ability to extract price and expenditure elasticities from available survey data. It allows for the possibilities that there are cluster lever fixed effects in demand patterns, effects that may be correlated with average village incomes, unit values that are not prices but rather a mixture of price and quality effects, and the existence of non-independent measurement error in the reported unit value and quantity data. It also accounts for zero expenditure and is the formulation of interest to policy makers. Being linear, it simplifies estimation and is identified from the data.

Descriptive results show that there has been little change in regional food consumption patterns. This is attributed to the negative impact of civil strife that saw household incomes remain stagnant over much of the past three decades. Rural households still allocate up to two-thirds of their monthly household expenditures on food.

The effect of household demographic factors (age, sex, education and household size) on household food demand was minimal. This implies that the use of targeting programs to alleviate the nutritionally disadvantaged sections of the society may fail to meet their objectives when based solely on demographic factors.

Food quality attributes appear to have little influence on food demand. Ugandan households appear to still be concerned with getting enough to eat as opposed to its quality.

Model results showed high expenditure elasticites for food typical of developing country. Rural expenditure for food was, as expected, higher than their urban counterparts.

The regional own-price elasticities were quite large but mostly insignificant. Several cross-price elasticities were significant and quite elastic which indicates substitutability among the seven food staples analyzed.

The high expenditure elasticities across regions show Uganda households are generally low-income and will tend to increase their consumption of food staples with an increase in per capita expenditures/income. The large cross-price elasticities suggest high sensitivity to price changes resulting in high substitution amongst the mostly starchy staples consumed. It implies that the food staples are close substitutes such that minor price changes lead quick substitution to cheaper staples.

Recommendations from the study suggest further studies incorporating food security concerns and at a much lower level of household aggregation to properly elicit food consumption patterns of particularly those areas prone to food insecurity such as the north-east of the country. In addition, the government needs to continue carrying out periodical household consumption surveys to generate time series data that can be used in conjunction with household budget surveys to properly establish consumption demand patterns of Ugandan households. This information can be used to make more adequate food policies for the country.

CHAPTER 1
INTRODUCTION

1.1 The Importance of Food Staples in Uganda's Economy

The agricultural sector in Uganda accounts for 51 percent of gross domestic product (GDP). The growing of food crops is by far the main activity accounting for between two-thirds and three-quarters of total agricultural output. As the country continues to reverse years of economic decay, food crops have emerged as the main engine of the economy replacing traditional cash crops such as coffee, cotton and tea as the main source of income for most rural families. The present success of food crops has been a result of improved national security, better infrastructure, the adoption of free-market policies and increased access to markets in neighboring countries. Despite the strong showing of food production in the economy, it only surpassed 1970 production levels in 1988. The rapid growth recorded in the 1980s and early 1990s has simply reversed the declines suffered between 1976 and 1980. Population growth, on the other hand, did not slow down during the years of strife and, hence, per capita food production figures are well below those recorded in early 1970s [26].

There is debate as to whether or not the success the food economy now enjoys comes at the expense of national food security. Since agriculture in Uganda is rain dependent, its fortunes or losses are still largely dictated by prevailing weather. In normal weather periods, food prices are relatively stable and while this may be a boon for urban consumers, farmers are adversely affected. With the advent of greater openness in regional markets, farmers have, in recent times, been able to take advantage of new outlets for food sales. During inclement weather, food supplies are seriously curtailed leading to volatile food prices that, frequently, endanger the food security of households in the north and northeast of the country. Continued exports of food in such times is widely viewed as further eroding the food security of the nation.

The Uganda government has often been tempted to institute temporary bans on food exports during times of relative food scarcity. It is not clear if the bans have had the desired effect of arresting the outflow of food and, hence, stabilizing domestic food prices. As in most developing countries and, especially in light of the country's troubled past, there has been a lack of data on food demand parameters making it difficult to formulate effective food policies. Further complicating the picture is the fact that the country exhibits a wide range of diets and weather patterns. Hence, food shortages are often localized and not easily offset by internal redistribution of food supplies from other areas. Besides, those areas which have been frequently stricken with famine are also the poorest and, hence, usually unable to attract supplies from surplus areas without assistance from government or NGOs.

Studies on food demand in Uganda are scarce, and any findings made during the years of turmoil have to be treated with suspicion. Reasonably, reliable demand studies were conducted over a decade and a half ago and, given the evolution of the Uganda food patterns since, may not reflect food demand in present day Uganda [2, 15].

Coming to grips with food demand parameters in Uganda's current environment, acknowledging its troubled past, relegates us to using cross-sectional data. Following on the heels of the national Household Budget Survey (HBS) of 1989-90, the Integrated Household Survey (IHS) of 1992-93 provides a wealth of comprehensive basic household consumption data that is utilized in this study. The use of cross-sectional demand data calls for innovative demand formulations to address problems specific to its nature and that of developing country data. One important consideration, for instance, is the source of price variation used for the estimates. Household budgets are often analyzed with the assumption that all individuals face the same prices at a given time. In single-period surveys, then there would be no price variation and price parameters would not be estimable without strong assumptions [1]. For instance, Timmer et al. [20] point out that if budget surveys only collect expenditure data, it is hazardous to interpolate quantities of individual commodities consumed by the household during the survey period. This would only be acceptable if households faced the same prices for the various commodities in which case expenditures on a particular commodity could be divided by its average price to yield the quantity purchased. This, however, is usually not the case and four major factors impede assumption of such a calculation:

- Regional Price Differences. In the course of conducting household budget surveys it is common to find significant and often wide variations in commodity prices from one region to another. These are usually attributed to transportation costs which can be considerable in developing countries where transport infrastructures are often in poor condition or near to nonexistent. Proper calculation of purchased quantities will, however, call for specific regional commodity prices.
- Seasonal Price Differences. Commodity price variation will not only vary across regions but also within seasons. Time specific food commodity prices are hence required to convert expenditure data to quantities with a reasonable degree of accuracy.
- Quality Differences. In the market place, it is observed that the prices paid for a given commodity vary with its quality. Thus, rice of a higher quality grade will fetch more that of a lower grade. Simply dividing total expenditure by quantity will not provide an accurate commodity price but instead a value that also incorporates quality attributes of the commodity.
- Zero Consumption. In household budget surveys not all respondents will have consumed a given good during the survey period. From the stand point of estimation, nonconsumption or zero-value observations may bias the estimates. For instance, if the true model is

  $$q = \beta x + u \text{ or } u = q - \beta x,$$

  where q is quantity and x is expenditure. Then because $q \geq 0$ for all cases, the distribution of u is nonnormal which leads to biases in OLS estimation [1]

These and other functional problems that arise in the analysis of household budget data are addressed and overcome by employing an analytical demand model developed by Deaton [6, 7, 8].

1.2 Background to Uganda's Agriculture

Uganda has wide ranging soils, rainfall and altitudes that enable it to produce a diversity of crops and livestock. The total land area is estimated at 19.4 million hectares with the following distribution: 4 million hectares for annual crops, 1.5 million hectares for permanent crops, 5 million hectares for pastures and grazing, 6.5 million hectares for forests and 2.4 million for marginal use (urban areas etc.).

According to the most recent national census figures of 1989, 89 percent of Uganda's population is rural, and small-scale subsistence agriculture remains its primary means of livelihood. The wide engagement of the population in small scale agriculture and the combination of good climate and easy access to arable land ensured people remained adequately fed even during the peak years of political and military turmoil from 1979 through 1986. Smallholders dominate the agricultural sector in Uganda, both in terms of the number of producers and the value of output. Even major cash crops such as coffee and cotton have been characterized by the absence of plantation-style development. Food crops have been almost exclusively cultivated by smallholders. The average cultivated area per family is 1.4 hectares. Food crops dominate agricultural production in terms of contribution to GDP as well as land under cultivation. Because the production of food crops is dominated by smallholders, a significant proportion of the benefits derived from domestic trade and export of food crops directly enhances the revenue of a large number of rural people.

1.2.1 Agriculture Labor Force

Drawing from the HBS survey, the World Bank [26] concluded that most Ugandans work in the rural economy and are predominantly employed in agriculture. Eighty nine percent of the Uganda labor force was employed in the rural economy—a slightly higher percentage than that of total rural population. Close to 80 percent of total labor force and more than 87 percent of the total rural labor force was employed in agriculture. Within the urban sector, agriculture employed 18 percent of the total urban labor force. Most agricultural employment was in household farming based on a very high degree of labor intensity. According to a World Bank study [27], the average amount of land worked is 0.9 ha per worker. The study estimates that the amount of land per agricultural worker could be raised to 3 ha if labor and/or complementary resources to bring more land under cultivation were available. It concluded that relative to land, labor was the scarce factor of production.

Primary cultivation is mostly by hand, which limits total production. Due to the high cost of imported tractors and fuel, mechanical cultivation is very limited. Where tractors are available the cost is often prohibitive for most farmers. Tractors are typically used only for primary tilling. The critical shortage of oxen is a major constraint to total output. Oxen ploughing is very popular in the northeast region of the country where flatness of the land and the lightness of the soil are encouraging features for this type of farming. At one time, the Ugandan small-farmers were some of the most efficient and effective users of work-oxen in Africa [17]. The decline in the number of draught animals during civil strife has seriously reduced farm household incomes. This is a result of both the loss in direct income from livestock and livestock product sales, as well as a decrease in cropped area associated with the reduction of available animal traction resources.

1.2.2 Land Tenure

Land tenure systems differ across Uganda. Tenure practices are a mix of traditional practice, colonial, and post-colonial regulation. Before the Land Reform Decree of 1975 there were four main types of land tenure in Uganda: customary tenure, freeholds (ordinary and adjudicated), Mailo tenure (owners and tenants) and leaseholds [14].

Customary tenure is the most widely used system, and prevails outside the pre-colonial kingdoms of Ankole, Buganda, and Toro. Conditions vary by ethnic group and location. Customary tenure did not recognize individual ownership of land, but did recognize the rights of individuals to possess and use land subject to the superintendency of family, clan and community. Freehold rights were provided under the British Government Agreements with the Buganda (1900), the Ankole (1901), and the Toro (1900) Kingdoms.

Within Buganda, a system of mailo-tenure was established, whereby members of the nobility received freehold rights to estates (determined in square miles). Much subdivision of mailo holdings has occurred since 1900. Mailo land titles have become easily transferable, smoothing the development of a land market and its use as security. Leaseholds, on the other hand, are provided by private owners, or by government under the Public Lands Act of 1969.

In 1975 the Government of Idi Amin promulgated a Land Reform Decree. The decree was revolutionary in that it nationalized all land and introduced a uniform system of tenure. The goals of the decree were to facilitate the use of land for social and economic development and to introduce land use planning, including the use of zoning.

All said, there is nearly universal access to land and only negligible incidence of landlessness. The HBS reported a total of 2.9 million households (2.5 million rural households) of which 2.4 million households had farm land. It also estimated that 2 percent of the agricultural labor force is located in the urban areas. Using these figures and assuming uniform distribution of landownership among rural and urban households, 95 percent of the rural households can be said to have land [27].

The relative returns on the production of food versus cash crops has been above the levels of the early 1970s. This trend coupled with universal access to land has led to a rise in wages needed to hire labor away from own–production. In turn the rise of labor costs has squeezed profit margins on estates. The results have been lower returns to export–crop production and a decline in farmers' time devoted to export crops. This trend has lowered yields and quality. This has led to a situation where rural families now depend more on food crops and daily products for cash, rather than the export crops of the 1970s [26]. Increased access to regional food markets to cater to the refugee populations and to make-up for seasonal shortfalls have made food production more attractive.

1.2.3 Climate, Relief and Farming Systems

Uganda, on the whole, enjoys a favorable agricultural climate. The country lies on the equator but because two-thirds of the country is at an elevation of 1000 to 2500 meters, its temperatures average 21 (70° F) degrees centigrade, ranging from 15 (60° F) to 30 (86° F) degrees. Rainfall is fairly reliable, and varies from 750mm (30 inches) per year in Karamojong pastoral areas in the Northeast, to 1500mm (60 inches) per year in the high-rainfall areas on the shores of Lake Victoria, around the highlands of Mt. Elgon in the east, the Ruwenzori mountains in the southwest, Masindi in the west, and Gulu in the north. South of the equator there are two growing seasons [26]. A regional map of Uganda is provided in Appendix B.

Based on soil types, rainfall amounts and cropping characteristics, Parsons ([12] pg. 127) has defined five agricultural production systems. In the first group are the high-rainfall areas around Lake Victoria, with bananas, Robusta coffee, and food crops grown in mixed farming systems. In this system fallowing is minimal.

In the second group are the Teso systems found in Eastern Uganda. They are characterized by annual crops grown in two distinct rainy seasons. The rains are separated by a four-month dry period. In this system, finger millet has been replaced by cassava as the main food crop. Cotton used to be the main cash crop but has seen its production levels drop dramatically from those of the 1970s. This region was also home to large herds of cattle prior to civil disturbances in the mid-80s and early 90s. Use of draft-ox-power was widespread, and intercropping, rotations, and fallow periods were commonly practiced to maintain fertility and minimize soil erosion.

The third group is designated as the Northern System. It covers the Northern region and extends to the northwest of the country. Rainfall patterns, in this system, restrict cultivation to one season. There is a distinct decline in rainfall totals as one moves from south to north. In the central zone of this system, communal cultivation is customary. Annuals, such as cotton, maize, and finger millet are common. Further south, groundnut and sweet potato are more common, with sunflower and tobacco the main cash crops.

Fourth, the mountain systems in the west and in the east feature bananas as the main food crop, with Arabica coffee and tea as cash crops. The higher altitudes permit cultivation of temperate fruits, vegetables, and Irish potato, as well as some of the traditional food crops.

The last group is referred to as the Pastoral System. This group is found in the northeast, rainfall totals are less than 800mm (31.5 inches) per year. Pastoral livestock production is combined with sorghum and millet cropping.

1.2.4 Uganda's Staple Foods

Six major food staples, namely, matoke (green bananas), cassava, sweet potatoes, millet, sorghum and beans account for the large share of food crop production.

Matoke (Bananas)

Matoke is the major staple food crop in the high rainfall areas of the country, bordering Lake Victoria and the middle section of the country running from east to west and extending south. Matoke occupies the single largest cultivated acreage estimated at 1.5 million hectares in 1992 [26]. Yields are comparatively low averaging 5.5 tons per ha because of declining soil fertility and disease and pest problems. With proper soil and pest management farmers can potentially obtain yields of 10-20 tons per ha. There are three major banana categories grown: green cooking bananas; small yellow bananas eaten as dessert and used in the brewing of local beer; and, long sweet bananas locally referred to as *Bogoya*. Trading in bananas is a major activity and is a source of livelihood for a number of households in both the rural areas where they are grown and the urban centers where they are sold.

Cereals

The three main cereals produced in Uganda are millet, maize and sorghum. Rice production has increased over the last decade to be considered one of the main cereals produced in Uganda. Finger millet and Bulrush millet are the two main varieties of millet grown. Finger millet is grown mostly in the drier and less fertile areas in the east and north of the country but can also be found in the western region. Bulrush millet is confined to the semi-arid areas of Karamoja in the north-east of the country. Millet is highly nutritive, has a high tolerance for drought and when dried is easy to store. These attributes make it an attractive food security crop, hence, its popularity in the more arid regions. Millet also is a key ingredient in brewing local beer. There were sharp declines in millet production between 1970 and 1982, from 783,000 metric tons to 401,000 metric tons. A figure of 600,000 was reported for 1992 showing modest recovery. Experimental research stations have achieved yields of up to 3 tons/ha with improved varieties and better crop management, however, on average, farmers only get 0.8 tons/ha.

Maize is second to millet in total output among the cereals grown in Uganda. Historically, maize was a minor food crop but has since become a major food and cash crop. Acreage under maize expanded rapidly during the 1980s from 260,000 ha in 1981 to 440,000 ha in 1992. Despite this increase in area cultivated the yields remain low, fluctuating between 1.2 and 1.5 tons/ha. While climatic conditions favor maize production, there is a lack of suitable varieties and limited application of proper agronomic practices. Maize has found wide acceptability as a food staple, especially in educational institutions and hospitals, and in police, army and prison establishments. Its wide appeal is due to its favorable price when compared to more traditionally established staples such as matoke and millet, ease of preparation and storage. It is either eaten as porridge or more commonly prepared as a thick paste (maize meal) that is accompanied by a stew. It is a key ingredient in animal feeds and has experienced increased demand from an expanding poultry and livestock industry. It is also one of the few food crops that is currently exported successfully within regional markets. Uganda produces only white maize. However, international trade is mainly in yellow maize. In regional markets white maize is preferred and, hence, Uganda has a competitive advantage in this market.

Sorghum is a staple food as well as a raw material in local beer brewing. Like millet it is grown predominantly in the drier areas of Karamoja and Teso but is equally adaptable in the highlands of Kabale in the southeast point of the country. While the area planted to sorghum has remained about the same since the early 1970s, yields have suffered and currently average 0.8 tons/ha. With proper crop management and better varieties yields of 3 to 4 tons/ha have been achieved.

Roots and tubers

The two major crops in this classification are cassava and sweet potatoes. Cassava is second (first, according to a 1994 survey report issued by the Ministry of Agriculture, Animal Industry and Fisheries) to bananas in terms of output. It is the main staple in the eastern, northern and northeastern parts of the country but has recently become a major staple in the central and western regions. Its attractiveness is due to its cheapness and ease of growing (does well over a wide range of agro-climatic conditions). It can be left in the ground for long periods of time after its maturity and harvested in a staggered fashion which is an important poor man's deep freezer that can make a major difference in times of food scarcity. Cassava is the only crop whose average yields increased during the years of turmoil. Current yields are estimated at 9 tons/ha, up from 5 tons/ha in 1970. Current yields, however, remain considerably below the potential with proper crop management and improved varieties.

Prudencio and Al-Hassan [22] found that under increasingly difficult environmental and economic conditions often facing the African farmer, cassava is turning out to be more useful than other crops in satsfying the increasing food needs of the rapidly growing population. Consequently, cassava production has been expanding at the expense of other crops.

Sweet potatoes are grown mainly in the south and west of the country. They rank third after bananas and cassava in terms of importance. They store well in the soil as famine reserves but not for long periods as in the case of cassava. They withstand extreme weather and do well in marginal soils and are, hence, grown in virtually all areas of the country. As with other major food crops they are grown both for food and cash income. Observed yields are still well below potential at an average of 5 tons/ha. Yields of 35 tons/ha have been realized in the east and north of the country.

Pulses

Under this category beans are the only food meriting staple status. They are grown mainly in western parts of the country but significant quantities are also grown in the central, eastern and northern regions. They are a cheap source of vegetable protein in the Ugandan diet and have also demonstrated remarkable export potential. They are easily stored in dried form and, hence, can be eaten over time. Yields remain depressed at only 0.6 to 0.8 tons/ha compared to a potential of 1.5 to 2.0 tons/ha.

The food crops so far reviewed provide over 90 percent of average gross volume of food consumed by Ugandan households. These food crops and beef (reviewed below) will provide the focus of this study's estimation of demand elasticities. A more comprehensive list of food crops consumed in Uganda with average budget shares of over 1 percent is contained in Table 1.1.

Beef

Beef in many Ugandan households remains a rare delicacy. Apart from cattle, the other sources of meat are poultry, pigs, goats and sheep. There are still a number of rural communities whose meat needs are supplemented by traditional hunting. In 1990, annual

Table 1.1: Average Budget Shares of Foods Commonly Consumed in Uganda

Food Item	Average Budget Share
Matoke	8.67
Sweet Potatoes	5.64
Irish Potatoes	1.01
Cassava	6.22
Rice	1.15
Maize	4.90
Millet	2.29
Sorghum	1.41
Beef	3.43
Nile	1.15
Tilapia	1.55
Milk	2.98
Dodo	1.39
Beans	4.44
Sugar	3.13

domestic meat consumption was estimated at 55,000 tons—about 3 kg per capita. An income elasticity of demand for livestock products of 1.5 was estimated by the Ministry of Finance and Economic Planning using the 1989-90 Household Budget Survey (HBS) data [26].

In 1990-91 the cattle population was estimated at 4.3 million heads by the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF). Results from the HBS show the west and southwest as having the largest cattle herds with about two heads per household on average. This number is approximately one per household for the rest of the country. Civil insecurity and cattle rustling in the north and northeast of the country is said to have diminished the cattle population by 25 percent in 1987 according to MAAIF statistics.

1.2.5 The Incidence of Regional Poverty in Uganda

Rural poverty

The level of poverty among rural households may be gauged by the number of households falling in different monthly household income categories. According to Table 1.2, the northern region has the highest number of households in the poorest category followed by the east the west and with the central region having the least. Only in the central region do we find households in the highest income bracket. These findings are consistent with those in the earlier HBS survey of 1989-90. Over 90 percent of all Ugandan rural households earn less than Shs. 100,000 per month (approx. $100). Seventy percent have a per capita monthly income of less than Shs. 10,000 (approx. $10). With the rural population accounting for over 93 percent of the country's population, it is clear that most people are poor indeed. The HBS used a poverty line of Shs. 6000 per capita and found 55 percent of the population fell under this line.

Table 1.2: Percentage Distribution of Rural Households by Monthly Household Income

Monthly Household Income ('000 Ug. Shs.)	Central	East	North	West
0-50	64.0	71.8	78.3	65.6
50-100	25.1	21.5	17.4	26.5
100-150	7.2	3.9	2.0	6.1
150-200	1.8	1.5	1.1	1.0
200-300	1.0	0.9	0.8	0.6
300-400	0.4	0.3	0.2	0.2
400-500	0.2	0.1	0.1	0.1
Above 500	0.3	0.0	0.1	0.0

Source: Report on the Uganda National Integrated Household Survey 199293. World Bank/UNDP Project UGA/91/R02SDA Survey Statistics Department, Ministry of Finance and Economic Planning.

Table 1.3: Percentage Distribution of Urban Households by Monthly Household Income

Monthly Household Income ('000 Ug. Shs.)	Central	East	North	West
0-50	29.6	49.8	48.9	46.6
50-100	35.8	33.0	36.6	3.5
100-150	11.7	9.0	6.8	7.5
150-200	8.1	3.1	3.6	4.7
200-300	6.0	2.4	1.5	4.0
300-400	3.1	1.0	1.7	1.5
400-500	2.0	0.9	0.3	1.1
Above 500	3.7	0.8	0.6	1.1

Source: Report on the Uganda National Integrated Household Survey 199293. World Bank/UNDP Project UGA/91/R02SDA Survey Statistics Department, Ministry of Finance and Economic Planning.

Urban poverty

Compared to the rural figures there are considerably fewer households falling in the lowest monthly income bracket of Shs. 0–50,000 in all urban regions (Table 1.3). The central urban region enjoys the lowest figure followed by the west, the north and finally the east. Generally, there are a negligible number of households earning more than Shs. 500,000.

In the central urban region, 3.7% of its households earn a monthly income of more than Shs. 500,000, more than the combined total of all the regions for this income category in Tables 1.2 and 1.3. The absence of a middle class is apparent. Most households are very poor with only a token number of wealthy households.

1.2.6 Food Consumption Patterns in Uganda.

According to results of the IHS survey (1992-3), Ugandan households devoted on average 59.2 percent of their total expenditures on food(Table 1.5). For rural households the average expenditure on food was 66.7 percent—higher, as expected, than the corresponding urban figure of 51.7 percent. Among rural households those in the west had the highest food budget share followed by the north, east and central regions(Table 1.4).

Table 1.4: Budget Shares of Selected Food Staples in Rural Regions of Uganda

Food Staple	Central	East	North	West
Matoke	15.6	9.1	0.8	25.8
Sweet Potatoes	11.3	10.4	6.8	12.32
Cassava	13.1	12.8	13.8	7.0
Maize	10.0	9.5	7.0	4.8
Beef	5.8	5.6	3.5	3.3
Beans	7.0	4.1	8.4	12.2
All food	62.8	64.3	66.7	72.9

Table 1.5: Budget Shares of Selected Food Staples in Urban Regions of Uganda

Food Staple	Central	East	North	West
Matoke	16.1	7.5	1.2	20.2
Sweet Potatoes	5.3	4.5	4.5	6.5
Cassava	5.7	8.1	11.9	4.8
Maize	6.9	8.3	10.3	5.6
Millet	0.7	1.7	1.6	1.4
Beef	8.3	8.3	10.3	8.0
Beans	3.7	3.7	9.3	7.8
All food	43.2	55.34	54.8	53.5

Vulnerability to inflation and weather changes

The harvest period in Uganda differs by crop and geographical location. Some crops such as matoke and cassava, however, can be harvested throughout the year. Several annual crops such as sweet potatoes, beans, millet, sorghum and others, can be grown two to three times a year in areas offering two distinct growing seasons. There are areas in the north and east of the country that are characterized by one growing season. For farming households (over 90 percent of Uganda's households), harvest is a time of plenty, while post–harvest is usually lean even for those who are otherwise considered well-to-do. The well-being of net-buying households in rural areas, rural and urban wage earners, and otherwise well-to-do farmers suffer when prices swing upward seasonally on their long-term trend [26]. While this agricultural cycle is familiar to most of these households, weak post-harvest storage conditions, poverty and near absent government support leaves most of them vulnerable to these seasonal variations. The severity of these fluctuations is now much more encompassing with increased dependence on food crops for cash.

1.3 Problem Statement

An overwhelming majority of Ugandans depend on agriculture for their livelihood. Food production is the most widespread economic activity in Uganda. It accounts for 74 percent of agriculture GDP, which in turn is 60 percent of total national output. Food crop prices tend to be more volatile than those for cash crops. The present shift in emphasis by farmers to food crop production means that their incomes are now more dependent on food production and, hence, quite vulnerable to food price fluctuations. The possible impacts of these price fluctuations on Ugandan households are not clearly understood due to a lack of studies in this area. Moreover, because consumption patterns differ from one region to another, regional impacts will most likely also differ.

The highly disorganized and botched attempts to respond to serious famine that ravaged the north-east countryside in 1994 could have been minimized with a clear understanding of effects of price and income changes on the demand for food by households in this region.

1.4 Hypothesis

Understanding the pattern and characteristics of demand for food staples by Ugandan households will provide valuable information for planners, NGOs and government officials in their attempts to shape Uganda's food policy. A firm knowledge of the regional effects of food price and income changes on the acquisition of food by households in urban or rural locations is important in projecting demand and in planning to meet the demand for food.

1.5 Research Objectives

The main objective of this study is to estimate urban and rural household demand elasticities of food staples in each of Uganda's four regions by applying Deaton's demand model to cross-sectional data collected by the Ministry of Finance and Planning in the National Household Integrated Survey (IHS) of 1993-1994. Secondary objectives include a detailed description of the food economy of Uganda and a review of current and past regional food consumption patterns.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

The effect of government policies on people's food consumption and nutrition is largely determined by the resulting changes in income and prices and the response of the people to such changes. To understand how people change their food consumption patterns when basic decision parameters change requires the analysis of descriptive evidence collected on representative samples of households. Food consumption analysis at the household level attempts to determine the likely impact on food demand when there are changes in the economic circumstances of the households in question. Economic theory provides a basis for understanding the decision making framework under which food consumption decisions are made and helps provide a rationale to formulation of food policies.

2.2 Review of Household Consumer Theory

Consumer theory provides for the derivation of demand equations for an individual. However, household survey data usually relates to households rather than individuals. In this study a household is defined as a group of people living together and consistently eating together. With this definition we can make the assumption that decisions about food purchases are made for the household as a unit rather than for individuals. This assumption helps us extend the analysis to the household level [4].

The extensive literature on social choice, social welfare function, and the aggregation problem that is closely linked to this subject will not be reviewed here. For our purposes, the existence of a household utility function will be assumed.

A decision making unit, hereafter a household, faces the fundamental economic problem of how to allocate income among many available and competing needs (commodities). Consumer theory provides a conceptual framework for this allocation problem. According to theory, a household (acting rationally and consistently) chooses among available alternatives so as to extract the maximum utility possible. The household utility function contains all information about the satisfaction the household derives from consuming the various commodities [4].

Three properties are used to define the commodity set: (1) the non-negativity property, (2) the divisibility property, and (3) the unboundedness property. The first states that no commodity bundle may have negative components. The second, in conjunction with the first, means that, given a bundle $q^0 = (q_1^0, ..., q_n^0)$, then any bundle of the form $\alpha q^0 = (\alpha q_1^0, ..., \alpha q_n^0)$, for which $0 \leq \alpha \leq 1$, may be extracted from this bundle. The third property states that the commodity set contains the bundle $(0, ..., 0)$, and, moreover, if a bundle q^1 belongs to the set, then any bundle q^2, where $q_i^2 \geq q_i^1$ for all i also belongs to the set, that is the set is treated as unbounded from above [23].

2.2.1 Preference Axioms

The preference axioms (comparability, antisymmetry, transitivity, continuity, monotonicity, convexity, and differentiability) will not be elaborated on here, but are necessary and sufficient conditions to insure the existence of order-preserving, monotonic, quasi-concave, real-valued continuous utility functions [10].

The combination of these axioms with the utility function concept and the commodity set concept has consequences for applied demand work. Specifically, a given preference ordering defines a set of demand relationships. When preferences change, this set also changes since the form of the utility function determines the form of the demand relationships. The implicit assumption in any empirical analysis is that the utility function does not change over the observation period [23].

2.3 Properties of Demand Systems

Neoclassical model demand systems are expressed in terms of mathematical restrictions on the derivatives of the demand equations.

2.3.1 System of Demand Equations

We assume that the typical consumer has a given income (or total expenditure), y, and is faced with a choice among alternative commodity bundles from the commodity space. Denoting $p = (p_1, ..., p_n)$ as a vector of prices per standard unit of the commodities in the various commodity bundles, and treating p and y as fixed, the consumer choice problem can be summarized as selecting the bundle that maximizes utility $U = U(q)$, where $q = (q_1, q_2, ..., q_n)$, subject to the budget constraint $\sum_{i=1}^{n} p_i q_i \leq y$. Following from the axioms above, the utility function is assumed to be strictly increasing, strictly quasi-concave, and twice continuously differentiable [4].

The consumer problem outlined above, under certain regularity condition, can be solved by application of differential calculus, in particular, the Lagrange technique. Using this technique and assuming the income constraint is binding, one forms the Lagrangian

$$L(q, \lambda) = U(q_1, ..., q_n) - \lambda(p_1 q_1 + ... + p_n q_n - y), \tag{2.1}$$

where λ, the unknown scalar, is the Lagrangian multiplier, interpreted as the marginal utility of income. Differentiating 2.1 with respect to q and λ yields the first-order conditions

$$U_i - \lambda p_i = 0; \qquad i = 1, 2, ..., n \tag{2.2}$$

$$y - pq = 0$$

where $U_i = \frac{\partial U}{\partial q_i}$ is the marginal utility of the ith commodity. Under conditions for the implicit function theorem, the system of equations in 2.2 can be solved uniquely for $q_1, q_2, ..., q_n$ and λ in terms of prices and income. The result is a set of Marshallian demand functions

$$q_i = q_i(p, y); \qquad i = 1, 2, ..., n. \tag{2.3}$$

The functions in 2.3 give the quantities of the n commodities that maximize utility for a consumer faced with prices $p_1, p_2, ..., p_n$ and having income y [4, 23].

2.3.2 General Restrictions of Demand Functions

A system of demand functions derived from utility maximization should satisfy a number of restrictions. Under the classical theory framework, the Engel aggregation condition is:

$$\sum_{i=1}^{n} p_j \frac{\partial q_i}{\partial y} = \sum_{i}^{n} \frac{(\partial p_i q_i)}{\partial y} = 1; \qquad (i, j = 1, 2, ..., n). \tag{2.4}$$

Tthe Cournot aggregation condition is

$$\sum_{i=1}^{n} p_i \frac{\partial q_i}{\partial p_j} = \sum_{i=1}^{n} \frac{(\partial p_i q_i)}{\partial p_j} = -q_j. \tag{2.5}$$

The homogeneity conditions are

$$\sum_{i=1}^{n} p_j \frac{\partial q_i}{\partial p_j} + y \frac{\partial q_i}{\partial y} = 0; \qquad (i, j = 1, 2, ..., n). \tag{2.6}$$

and the Slutsky symmetry conditions are

$$\frac{\partial q_i}{\partial p_j} + \frac{\partial q_j}{\partial y} q_j = \frac{\partial q_j}{\partial p_i} + \frac{\partial q_j}{\partial y} q_i, \tag{2.7}$$

or

$$k_{ij} = k_{ji} \tag{2.8}$$

The substitution terms k_{ij} (in addition to the symmetry condition) also have the following properties:

$$\sum_{i}^{n} k_{ij} = 0; \qquad (i, j = 1, 2, ..., n). \tag{2.9}$$

$$k_{ij} \leq 0. \tag{2.10}$$

Demand functions derived from the maximization of utility functions, as in above, are expected to conform to these restrictions.

The homogeneity, Engel aggregation, and Counot aggregation conditions result from the fact that the demand functions 2.3 must satisfy the budget constraint. The homogeneity condition implies "absence of money illusion," which implies that a proportionate change in all prices and income will leave the quantities demanded unchanged due to the fact that the demand functions are homogeneous of degree zero in prices and income. The Engel and Cournot aggregation conditions imply that changes in prices and income result in the reallocation of quantities that do not violate the budget constraint. The symmetry conditions 2.7 and 2.8 are implications of the so-called "Slutsky equation" or "fundamental equation of the theory of value".

The general restrictions of demand equations reviewed above, apply to any demand system obtained by constrained utility optimization. They are always effective, whatever the form of the utility function. They are useful in empirical work because they provide a means for testing the consistency between the theory and observed consumer behavior. They also substantially reduce the number of parameters to be estimated. From a statistical viewpoint, the imposition of these restrictions results in more efficient parameter estimates.

2.4 Factors Affecting Household Demand for Food Staples

Household demand for food staples is a function of several variables. Key among them is the price of the staple in question, the prices of complementary and substitutable items, household income, demographic variables and tastes or preferences. In the short to medium term, the major determinants are prices and incomes.

A change in price of a given food staple has two effects, the income effect and substitution effect. The substitution effect is such that a negative change in the price of the staple will always lead to a positive change in the quantity of the staple demanded. The income effect will, however, depend on whether the staple is "normal" or not. A normal good is described as one whose change in quantity demanded will be positive with a positive change in income (implicit from the fall in the price of the staple). If on the other hand a commodity is "inferior" (a positive change in income bringing about a negative change in the demand of the staple), the income effect will be negative and therefore partially offset the substitution effect since it will work in the opposite direction. The overall effect for an inferior good is still, however, that a price fall (or rise) will lead to an increase (or decrease) in the quantity demanded. The exception is called a Giffen good, in which the positive income effect is larger than the negative own substitution effect and the own-price derivative is then positive. To contrast, the effect of a change in income with no corresponding change in the price of the staple, depends on whether the good is normal— in which case an increase in income increases the quantity demanded —or inferior—an increase in income decreases the quantity demanded.

Household demand for different food items also depends on a variety of demographic factors, including the number and age of household members and the age, sex and education of the household's principal food purchaser. The age of household members affects demand in two ways. First, children and elderly people eat less on average. Second, children have different consumption patterns from adults although this may be less so in poor, developing countries. The age, sex and education of the principal purchaser of food influences household diets. In addition, the size of the household may exert an independent effect on demand–the "household scale effect".

Tastes or preferences include such factors as seasonal variations in consumption patterns for reasons other than seasonal price variability, religious and social taboos and lack of familiarity with particular foods.

There are a number of elasticity measures associated with demand functions, each of which shows the responsiveness of demand to changes in a particular variable. An elasticity coefficient may be interpreted as the percentage change in quantity demanded in response to a 1 percent change in the relevant variable, *ceteris paribus*. The most important elasticities are:

- Own-price elasticity of demand: the percent change in quantity demanded in proportion to the percent change in its own price.
- Cross-price elasticity of demand: the change in quantity demanded in proportion to the change in price of another commodity. The cross-price elasticity can be positive or negative depending on whether the commodities are substitutes or complements.

- Income elasticity of demand: the change in quantity demanded in proportion to the change in income.

2.5 Theoretical Considerations

It has been widely hypothesized that in low-income countries of Africa such as Uganda, the income elasticity of demand for staple foods which provide the bulk of calories is low (below 1) and tends to fall as income increases. On the other hand the income elasticity with respect to meats, milk, imported stuff and non-food items is hypothesized to exceed 1 in all cases. Until recently, the influence of price has received little attention in consumption studies in Africa, largely because there have been few cases in which it was possible to estimate price elasticities. Consistent with economic theory, it has commonly been hypothesized that the demand for staples such as bananas, millet, sorghum and corn in Uganda, is price inelastic while that for foods such as rice, wheat, meats, beverages, services, and non-food items is price elastic. Several factors other than income and price have been hypothesized to have an important bearing on people's consumption patterns. These include size and composition of households, urban or rural locality, education and the degree of subsistence of the households.

2.6 Past Studies on Food Consumption in Uganda

In *Regional Supply Elasticities in Uganda's Cotton Industry and Declining Level of Cotton Output*, Alibaruho [2], examined how farmers in different regions of the country reacted to relative prices between crops or groups' of crops. His results showed the importance of the food crop factor in Buganda (now the Central region) *vis-à-vis* the other regions—the lower the price of cotton, the higher the acreage allocated to food crops. This was due to the fact that the Central region enjoyed better transport facilities and a higher level of urbanization; food crops were more readily sold compared to the rest of the country. In this aspect they too were cash crops and, hence, important in resource allocation to cotton production in accordance with standard economic theory. It can be seen that the cash earning roles of food crops were manifested early in the Central region and were interchangeable with those of traditional cash crops.

An examination of the determinants of expenditure by rural households in the Fort Portal area of Western Uganda was made by Massell and Parnes [15]. They estimated demand equations for13 groups of goods and services, using two-stage least squares (TSLS). The study was based on data on 65 households collected by the local agricultural officer. At the time of the study (1970), Uganda was experiencing a rise in per capita incomes that was resulting in major shifts in the composition of the demand for goods and services. They hypothesized that with a rise in household income, households would spend a smaller proportion of their income on staple food items and a larger proportion on luxury goods and services.

Their results showed that items such as milk and meat had high income elasticities, implying a shift to these luxury items from cheaper staple foods as incomes rise. Root-tubers had negative (although insignificant) estimated income elasticities. The result was consistent with the generally adopted view that root-tubers were inferior food items. A surprising result was a negative income elasticity for cloth.

Present per capita incomes are well below those prevailing at the time of the Massell study. We would in fact expect to see a reversal in diet composition of Fort Portal households reflected in higher budget shares for staple foods compared to luxury foods such as meat and milk as a result of the negative impact civil strife has had on the country's development.

CHAPTER 3
METHODOLOGY

3.1 Introduction

The model used here to estimate demand elasticities of staple food crops in Uganda was developed by Deaton. In it, food demand is modeled as a function of prices, total consumption and household demographics. It departs from traditional demand models using cross-section household data by treating the resultant ratios of dividing expenditures by quantities, not as prices, but instead as unit values which may have varying quality. While the unit values are expected to move with actual prices, they will vary from household to household as each of these households exercises choice based on the price and perceived quality of the foods.

The household consumption data section of the Uganda National Integrated Household Survey (UNIHS) contains observations on household food purchases in terms of quantities and their corresponding value (expenditure) for the last seven days and then for the last 30 days. It also contains data on quantities and value of food consumed out of home produced stocks and out of free collection or gifts in the last 30 days. Hence, in this aspect the UNIHS is similar to most other household budget surveys that report both expenditures and physical quantities of foods consumed but not their prices. Similar to the *Indonesian Survei Social Ekonomi Nasional* (SUSENA) data to which Deaton applied his methodology, the UNIHS collected data on clusters of households that live in the same locality that were surveyed at the same time and, hence, can be reasonably assumed to have exhibited no variation in prevailing market prices.

The lack of price variation would ordinarily render the exercise of estimating price parameters impractical without strong assumptions. When total expenditures are divided by their corresponding physical quantities a "price", or at the very least a unit value, v, (as Deaton prefers to call it) is derived. The reason Deaton prefers to call it a unit value and not a price is because it is really a combination of both the actual item price and its quality attributes. Without quality attributes the unit value is equivalent to the raw price of the food item in question. The presence of quality effects in computed unit values makes them vary less than proportionately with the "raw" commodity prices.

Deaton's methodology exposes the underlying spatial variation in prices. It does this through corrections made on unit values for quality effects and measurement errors. The resulting unit values can then be matched to demand patterns to estimate price and expenditure elasticities from household survey data

In the following sections, Deaton's methodology and how it deals with problems of quality, measurement error and fixed effects inherent in household budget data is presented. The data to which Deaton's methodology is applied in this study is reviewed in later sections of this chapter.

3.2 Quality Effects

Households respond to a price increase by either reducing their purchase of the food staple whose price has increased and/or by switching to cheaper and lower quality grades of the same staple. If survey records make no distinction between high and low quality grade foods the analyst is unable to distinguish between them. If then households switch to lower quality grades of the same food staple when prices increase, the quantity response will be attributed to a smaller price increase than that actually experienced. In this way, using unit values without controlling for quality may lead to bias in estimates of demand elasticity [5].

To further illustrate this, lets assume that all of the prices within a composite price vector move in tandem, then one can discuss the composite quantity response to a movement in the scalar used to describe the price vector's movements[1] . In the present analysis, that scalar will be referred to as the "cluster price" of the food staple, because in a given physical area the scalar is assumed to take the same value across a cluster of households. To take a specific example, assume there are two grades of food staple A and that in a reference market, these types sell for UShs. 100 and UShs. 200 per kg[2] . The vector of prices in the reference market can be written as: (Ushs. 100, Ushs. 200) per kg. If we take this to be our reference cluster ($c = ref$), then its price is assigned a value of $1 : p_{c=ref} = 1$. In a second cluster, due perhaps to higher transport costs or local market conditions, the prices for the two grades of food staple A are (UShs. 200, Ushs. 400) per kg. In this second cluster, then, $p_c = 2$.

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[1] See Deaton and Muellbauer [10], pp. 120-22, for a discussion of composite commodity prices

More generally, for a household, it can be assumed that the current price vector $V = (v1, v2, ..., vn)$ may be written

$$V = (p_c v_1^0, p_c v_2^0, ..., p_c v_n^0) \tag{3.1}$$

where $(v_1^0, ..., v_n^0)$ are reference-market weights (the level of prices of the composite's items in a reference market) and p_c is the price of the composite in cluster c, its value determined by such factors as transport costs and local market conditions [5]

The problem can then be seen as a latent variable problem as p_c is unobservable. One sees instead, for household i in cluster c, some quality weighted price

$$\begin{aligned} V_{ic} &= \frac{\text{composite expenditure}}{\text{composite quantity}} = \frac{X_i}{Q_i} \\ &= \frac{\Sigma V_j Q_j}{\Sigma Q_j} = p_c \left(\frac{\Sigma v_j^0 Q_j}{\Sigma Q_j} \right) \end{aligned} \tag{3.2}$$

where j is an index over food staples within the composite purchased by the household i. Expressing this in log form:

$$\ln V_{ic} = \ln p_c + \ln \left(\frac{\sum v_j^0 Q_j}{\sum Q_j} \right) \tag{3.3}$$

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[2] UShs. is the monetary symbol used for Uganda shillings. In 1993/4, the exchange rate was, on the average, \$1 = UShs. 1000.

Changes in p_c may induce changes in the quality of the food staples that a household buys. In turn, changes in the quality of food staples in the composite may mask observations of the change in p_c. In the example of food staple A, if the household sampled in the reference cluster [with price vector (Ushs. 100, Ushs. 200)] buys 5 kg of the high quality grade and 5 kg of the lower quality grade, the unit value of food staple A is calculated to be Ushs. 150 per kg:

$$\frac{\text{total expenditure}}{\text{total quantity}} = \frac{\text{Ush. } (100 * 5 + 200 * 5)}{10 \text{ kgs}} = \text{Ush. 150 per kg.} \tag{3.4}$$

Assume transport costs double the price of both grades of staple A between the reference and the second cluster [i.e. prices increase from (UShs. 100, UShs. 200) to (UShs. 200, UShs. 400)]. A household in the second cluster may not respond to the higher price solely by buying less of staple A in aggregate: it may also switch into lower grades of A. If a household in the second cluster buys 7 kg of low quality staple A and 2 bags of the higher quality, the unit value of staple A bought is:

$$\frac{\text{total expenditure}}{\text{total quantity}} = \frac{\text{Ushs. } (200 * 7 + 400 * 2)}{9 \text{ kg}} \approx \text{ Ushs. 240 per Kg.} \tag{3.5}$$

Thus while the cluster price doubled between clusters, the unit value increased only by 60%. The increase in p_c in this example leads the household to purchase a higher proportion of low grade staple A, which in formal terms reduces the value of the right-hand side term in equation 3.5.

As shown in the previous example, because of quality effects, the log cluster price, $\ln p_c$, may not move one-for-one with the log unit value, $\ln V_{ic}$. Deaton [6] showed that if the composite is weakly separable, the quality component of equation 3.5 will move in a predictable way with movement in the cluster price p_c. That is:

$$\frac{\partial \ln(\text{quality})}{\partial \ln p_c} = \eta \frac{\varepsilon_p}{\varepsilon_x} \tag{3.6}$$

where η is the quality elasticity defined by Prais and Houthakker[21][3] . The value ε_p is the cluster price elasticity and is defined as the percentage change in aggregate quantity demanded of the composite resulting from a percentage change in the cluster price, where the cluster price is the scalar which describes the composite price vector's movement. And ε_x is the expenditure elasticity. From equation 3.6, then, together with equation 3.5, movement in the log unit value relative to the cluster price can be expressed as:

$$\frac{\partial \ln V_{ic}}{\partial \ln p_c} = 1 + \eta \frac{\varepsilon_p}{\varepsilon_x}. \tag{3.7}$$

Using unit values in lieu of cluster prices in elasticity estimation may bias price elasticity estimates. In the food staple A example above, using unit values—instead of the cluster prices—to estimate the price elasticity overestimates the price elasticity. In the example, a 100% increase in cluster price led to a 10% reduction in aggregate consumption: the cluster price elasticity ε_p is -0.10. However, using unit values, the estimated elasticity would be -0.17. In equation3.7 it is quite clear that if the quality elasticity, η, is zero (i.e. there is no change in the quality of food staple purchased with a change in its price), then the unit value index moves proportionately with the market price of staple A ($\frac{\partial \ln V_{ic}}{\partial \ln p_c} = 1$). On the other hand, if the quality elasticity is positive, as would normally be the case, then the unit value will move less than proportionally with prices, the shortfall depending on the size of the quality elasticity as well as the overall price elasticity of food staple A [5, 7].

According to Timmer et al. [20], quality effects can also lead to an apparent rejection of the normally negative relationship between quantities purchased and the price. If consumers use the price to judge the quality of a given commodity, even if there is no real quality difference to justify the higher price, then higher prices could very well lead to greater consumption. Clear understanding of this potential role of the quality effect is very important when analyzing household food consumption data from budget household surveys.

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[3] See Prais and Houthakker (1955), The Analysis of Family Budgets, Chapter 8. The quality elasticity is defined there as the change in log of the unit value relative to the change in the log of total expenditure

3.3 Measurement Error

When estimating the parameters of a demand equation in which unit values are used in lieu of prices one runs a risk of measurement error. Because of the way unit values are constructed, measurement errors in expenditure and quantities purchased are carried over into the constructed unit values, biasing elasticity estimates. To illustrate, if the relationship between true ($\ln X_i^*$) and observed ($\ln X_i$) composite expenditure is

$$\ln X_i = \ln X_i^* + e_{1i} \tag{3.8}$$

for household or cluster i, and if the relationship between true quantity ($\ln Q_i^*$) and observed quantity ($\ln Q_i$) is

$$\ln Q_i = \ln Q_i^* + e_{2i} \tag{3.9}$$

then the resulting unit value will inherit both errors:

$$\ln V_i = \ln V_i^* + e_{1i} - e_{2i}. \tag{3.10}$$

With the exception of such special cases as $e_1 = e_2$,

$$E(\ln Q_i^* \mid \ln V_i^*) \neq E(\ln Q_i \mid \ln V_i). \tag{3.11}$$

For example, suppose we assume the relationship between $\ln Q_i^*$ and $\ln V_i^*$ is:

$$\ln Q_i^* = \alpha + \beta \ln V_i^* \tag{3.12}$$

but that the quantities and unit values are measured with error as in equations 3.9 and 3.10. In a regression of $\ln Q_i$ on $\ln V_i$

$$\ln Q_i = \alpha + \beta \ln V_i + u \tag{3.13}$$

b is an inconsistent estimate of β:

$$\operatorname{plim} \tilde{\beta} = \beta \left(\frac{u_*^2}{u_v^2} \right) - \left\{ \frac{(u_2^2 - u_{12})}{u_v^2} \right\} \tag{3.14}$$

where u_*^2 is the variance of in the true unit value $\ln V_i^*$; u_v^2 is the variance associated with the observed unit value $\ln V_i$; u_2^2 is the variance in e_2; and u_{12} is the covariance between e_1 and e_2 [7, 5].

3.4 Fixed Effects

In the estimation of demand elasticities using household budget survey data, consideration has to be made for the potential presence of area, or cluster specific fixed effects that represent unobservable taste variation from one cluster to another. If cluster specific fixed effects are present in a demand relationship and are correlated with the explanatory variables, ignoring them will lead to biased parameter estimates.

3.5 Model Conceptual Framework

The conceptual framework used here is largely based on Deaton's work contained in four publications[6, 7, 8, 9]. It envisages households choosing how much of a commodity to buy and in what quality or grade. A set of seven food staples are considered. Varying unit values are recorded within each commodity reflecting quality choices made by purchasing households. The choices of quantity and quality made by households are modeled as functions of household expenditure, household characteristics, and price. The analysis is composed of three distinct stages. At the first stage, the model uses the within-cluster variation in unit values and purchases to estimate the influence of income and household characteristics on quantities and qualities of the commodities in question. It does so while dispensing with price data which are treated as unobservable variables at this point following the assumption there is no variation in market prices within each cluster. Variation in within-cluster unit values is also used to separate out the effects of measurement error from genuine price variation. At the second stage, the inter-cluster variation in behavior partly due to price variation is isolated by using the estimates of quality effects and measurement error made at the first, within-cluster stage. In the third stage variances and covariances for the parameters and for the elasticities are derived.

Deaton considers his model a standard demand model where demand is portrayed as a function of prices, total consumption, and household demographics. While, observed unit values move with price, they are expected to vary from household to household because of differing quality choices made by household agents purchasing the same staple food. To properly analyze and differentiate these effects Deaton used two key equations, one for the budget shares, and another for the unit values. They are depicted as follows [8]:

$$w_{Gic} = \alpha_G^0 + \beta_G^0 \ln x_{ic} + \gamma_G^0 \cdot z_{ic} + \sum_{H=1}^{N} \theta_{GH} \ln p_{Hc} + (f_{Gc} + u_{Gic}^0), \tag{3.15}$$

$$\ln v_{Gic} = \alpha_G^1 + \beta_G^1 \ln x_{ic} + \gamma_G^1 \cdot z_{ic} + \sum_{H=1}^{N} \psi_{GH} \ln p_{Hc} + u_{Gic}^1. \tag{3.16}$$

The budget share, w_{Gic}, of food staple G consumed by household i living in cluster c, is derived by dividing the expenditure on the food staple by the total household expenditure, x_{ic} (see equation 3.15). The budget share is modeled as a log linear function of total household expenditure, x, N prices, and a vector of household characteristics z. The error term in the budget share equation is comprised of two components. The first, f_{Gc}, represents cluster-specific fixed effects that represent unobservable inter-cluster taste variation and can be thought of as 'residuals' in a cross-cluster explanation of purchases. Deaton assumes f_{Gc}, is orthogonal to the unobservable price term but does not necessarily have to be orthogonal to the observable explanatory variables, $\ln x$ and the z variables. The other error component, u_{Gic}^0, is assumed to account for errors arising from model specification and measurement error in quantities. The, u^0_{Gic}, term is assumed uncorrelated with all the other explanatory variables and has an expectation of zero within the cluster.

The non-standard econometric feature of equation 3.15 is that food prices, $\ln p_{Gc}$, are unobserved. In the place of prices, Deaton uses data on the unit values v, which are not identical to prices, but are related to them by equation 3.16. While budget shares are observed for all households, unit values in equation 3.16 are only observed for those households that record at least one purchase in the market of a specific food, G. Equation 3.16 depicts the logarithm of unit values, lnv_{Gic}, regressed on the same explanatory variables as in equation 3.15, but without the cluster-specific residuals, f_{Gc}. The parameter coefficient, β^1_G, is shown below to be the expenditure elasticity of quality. The error term, u^1_{Gic} is allowed to be correlated with u^0_{Gic} unless price is recalled perfectly and used to calculate either quantity from expenditure or expenditure from quantity. Barring this, measurement errors in quantity are expected to be correlated with those in expenditure both affecting the derived unit values in turn and, causing the correlation between u^0_{Gic} and u^1_{Gic} (see section 3.3).

Deaton cautions that equations 3.15 and 3.16 are not structural demand equations, and hence should not be regarded as direct representations of preferences but, rather, regression functions of budget shares and unit values conditioned on the right-hand explanatory variables. The advantages of this kind of formulation are (1) zero expenditures are accounted for; (2) it is the formulation of interest to policy makers; (3) being linear it simplifies estimation; and, (4) it is identified from the data. Apart from its inclusion of zero expenditures, it also differs from standard demand models in the sense that consumers choose both quantity and quality and, hence, expenditure is depicted not only as a product of quantity and price but also of quality too.

From equations 3.15 and 3.16, β^0_G and β^1_G, determine the total expenditure elasticities of quantity and quality. Knowing that $\beta^1_G = \frac{\partial \ln v_G}{\partial \ln x}$ and that unit value is simply a product of price and quality (see equations 3.2 and 3.3), β^1_G is then the expenditure elasticity of quality. If we denote the (expenditure) demand elasticity as ε_G, then differentiating equation 3.15 with respect to $\ln x$, gives

$$\frac{\partial \ln w_G}{\partial \ln x} = \frac{\beta_G^0}{w_G} = \varepsilon_G + \beta_G^1 - 1. \tag{3.17}$$

The last part of 3.17 results from differentiating with respect to $\ln x$,the definition of the logarithm of the budget share as the sum of the logarithms of quantity and quality less the logarithm of expenditure [8, ?][4] . In conjunction with the above equation, rearrangement of 3.17 gives

$$\varepsilon_G = (1 - \beta_G^1) + \left(\frac{\beta_G^0}{w_G}\right). \tag{3.18}$$

The matrix of own- and cross-price elasticities of the unit values is represented by, ψ_{GH}. In the situation where price is deemed to have no effect on quality, this matrix would be an identity matrix, prices would equal the unit values and all other explanatory variables in equation 3.16 would disappear. In practice, ψ_{GH} is found to be close to the identity matrix.

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[4] The budget share, w, is defined as:

$$w = \frac{qv}{x}$$

where q stands for the value of the quantity x, purchased, and, v, the intrinsic value of the quality of good G. Hence,

$$\ln w = \ln q + \ln v - \ln x$$

Differentiating with respect to $\ln x$, we get

$$\begin{aligned}\frac{\partial \ln w}{\partial \ln x} &= \frac{\partial \ln q}{\partial \ln x} + \frac{\partial \ln v}{\partial \ln x} - \frac{\partial \ln x}{\partial \ln x} \\ &= \varepsilon_G + \beta_G^1 - 1.\end{aligned}$$

The elasticities of quality with respect to the price are, generally, depicted as $\psi_{GH} - \delta_{GH}$, for Kronecker delta δ_{GH} [9][5] .

Defining ε_{GH} as the standard matrix of own- and cross-price elasticities of quantities, then differentiating equation 3.15 with respect to $\ln p$, gives[6]

$$\frac{\partial \ln w_G}{\partial \ln p_H} = \varepsilon_{GH} + \psi_{GH} = \frac{\theta_{GH}}{w_G}, \tag{3.19}$$

and with rearrangement

$$\varepsilon_{GH} = -\psi_{GH} + \frac{\theta_{GH}}{w_G}. \tag{3.20}$$

Since, in this formulation prices are treated as unobserved, other parameters may not be estimated without the help of prior information. For identification a formula linking the effects of prices on quality choice (ψ_{GH}) to conventional price and total expenditure elasticities is needed. This may be accomplished by assuming separability between the basic goods comprising each heterogeneous commodity. According to Deaton

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[5] The Kronecker delta matrix δ_{GH}, is defined as having the value 1 when $G = H$, and 0 when $G \neq H$ (G and H are integers).

[6] Again, from the definition $w = \frac{qv}{x}$,

$$\ln w = \ln q + \ln v - \ln x,$$

this time differentiating with respect $\ln p$,

$$\begin{aligned} \frac{\partial \ln w}{\partial \ln p} &= \frac{\partial \ln q}{\partial \ln p} + \frac{\partial \ln v}{\partial \ln p} - \frac{\partial \ln x}{\partial \ln p} \\ &= \varepsilon_{GH} + \psi_{GH} - 0 \\ &= \varepsilon_{GH} + \psi_{GH}. \end{aligned}$$

$$\psi_{GH} = \delta_{GH} + \frac{\beta_G^1 \varepsilon_{GH}}{\varepsilon_G}. \tag{3.21}$$

In 3.21 the price of good H can only be expected to affect the quality of good G only if there is an absolute cross-price quantity elasticity ε_{GH}. This effect would be felt through the change in total quantity of good G. The term β_G^1 is the elasticity of quality of good G with respect to its total expenditure.

If the relationship of the parameters holds when evaluated at the sample means, 3.18 and 3.20 can be substituted into 3.21 to obtain the following linkage of the underlying parameters:

$$\psi_{GH} = \delta_{GH} + \beta_G^1 \left(\frac{\frac{\theta_{GH}}{w_G} - \psi_{GH}}{1 - \beta_G^1 + \frac{\beta_G^0}{w_G}} \right). \tag{3.22}$$

Deaton defines the vector ξ for a given good G as

$$\xi_G = \left\{ \frac{\beta_G^1}{(1 - \beta_G^1) w_G + \beta_G^0} \right\} \tag{3.23}$$

Substituting this expression into equation 3.22 and rewrite it in matrix notation gives

$$\Psi = I + D(\xi)\Theta - D(\xi)D(w)\Psi, \tag{3.24}$$

where I is defined as the (NxN) identity matrix and $D(.)$ stands for a diagonal matrix and w is a vector of budget shares.

3.6 Statistical Considerations in the Estimation of the Model

Deaton makes several distinctions between his methodology and those often used in the analysis of panel data. He points out that, panel data typically consists of short time series on a large cross-section of individuals and that error structures that allow for fixed or random effects are specified. Additionally, there is a keen interest in estimators that remain consistent as the number of individuals in the cross-section part of the data increases while holding the time-series observations constant. In his methodology, however, the individual is represented by the clusters in the survey and time-series observations correspond to individual households in each cluster. In his application, as in the case of panel data, consistent estimators in the face of increasing cluster numbers while holding cluster size constant are required. Cluster sizes in household survey data are not expected to vary much. The assumption of a fixed effect in 3.15 allows each household in each cluster to share an idiosyncratic cluster effect that could represent shared preferences, locational, or climatic effects, or other factors. The possible correlation of the fixed effect with other right-hand variables, other than price, means that any estimation that does not take this into account, runs the risk of generating biased parameter estimates. These fixed effects are, however, not included in the second equation for this would destroy identification and preclude any inference about price from the unit values. On the other hand, the random errors u^0 and u^1 are allowed to have cluster components and be correlated. Along with their respective variances and covariances (σ^{00}_{GH}, σ^{11}_{GG}, σ^{10}_{GG}) defined below, they capture the spurious relationships between quantity and price that do not arise from genuine price responses. In the event that u^0 and u^1 are independent, σ^{10}_{GG} would equal zero. Equations 3.26 and 3.27 estimate only variances and covariances *within* goods. The off diagonal elements of covariance matrices 3.26 and 3.27 of the residuals *between* goods are assumed to be zero.

The parameters α, β and γ in equations 3.15 and 3.16 are estimated by OLS with cluster means subtracted from all data. Removing cluster means eliminates the cluster invariant prices in both equations and the fixed effects in 3.15. It is important to remember that estimates from equation 3.16 are only generated for households making market purchases. According to Deaton, the parameter estimates $\tilde{\beta}^0_G$, $\tilde{\gamma}^0_G$, $\tilde{\beta}^1_G$, and $\tilde{\gamma}^1_G$ remain consistent inspite of the procedure. These estimates are the final within-cluster parameter estimates for the effects of total expenditure and demographics. Deaton cautions that his demand formulation should not be confused with complete demand systems, still, the parameter estimates obtained observe the *adding-up condition* when non-zero observations are included in equation 3.15. The inclusion of non-zero share observations generates a classical multivariate regression system with identical right-hand variables that generates fully efficient parameter estimates when OLS is applied [8].

In the next step, the residuals arising from the within-cluster regressions are used to estimate variances and covariances (residual sum of squares, RSS) of the measurement errors, thus

$$\tilde{\sigma}_{GH}^{00} = (n - C - k)^{-1} \sum_{c} \sum_{i} e_{Gic}^{0} e_{Hic}^{0}, \tag{3.25}$$

$$\tilde{\sigma}_{GG}^{11} = (n_G^{+} - C - k)^{-1} \sum_{c} \sum_{i} (e_{Gic}^{1})^2, \tag{3.26}$$

$$\tilde{\sigma}_{GG}^{10} = (n_G^{+} - C - k)^{-1} \sum_{c} \sum_{i} e_{Gic}^{1} e_{Gic}^{1}, \tag{3.27}$$

where n_G^+ is the total number of households who report purchase of food staple G, n is the total number of households, and e_{Gic}^0, e_{Hic}^1 are the residuals from equations 3.15 and 3.16, respectively. It is worthwhile noting that in most cases there are relatively fewer households making market purchases especially in rural areas such that the off-diagonal elements of $\tilde{\sigma}_{GG}^{10}$ and $\tilde{\sigma}_{GG}^{11}$ will be based on households that make market purchases of both foods. The residual sum of squares (RSS) in conjunction with the results computed in the next step are used to correct for measurement error, commonly inherent, in the records of expenditures and quantities used to compute unit values. The presence of measurement error is indicated by the correlation between residuals in the budget share and the unit-value equations and is directly estimated by $\tilde{\sigma}_{GG}^{10}$ in equation 3.26.

The next step involves using the OLS estimates obtained in the first-stage within-cluster regressions to calculate the parts of mean cluster shares and unit values not accounted for by the first-stage estimation variables. Deaton [9] defines:

$$\tilde{y}^0_{Gc} = \frac{1}{n_c} \sum_{i \epsilon c} (w_{Gic} - \tilde{\beta}^0_G - \tilde{\gamma}^0_G \cdot z_{ic}) \tag{3.28}$$

$$\tilde{y}^1_{Gc} = \frac{1}{n^+_{Gc}} \sum_{i \epsilon c} (In\nu_{Gic} - \tilde{\beta}^1_G - \tilde{\gamma}^1_G \cdot z_{ic}) \tag{3.29}$$

where n_c is the number of households in cluster c, n^+_{Gc} is the number of households purchasing food staple G and tilded parameters are estimates from the first, within-cluster stage regressions. The right-hand variables in the above equations do not have their means excluded as is the case in the first-stage regression. The cluster means contain the price information that is excluded in the first stage regressions but must be included in the between-cluster regressions if price effects are to identified. According to Deaton [9], and based on the law of averages, as the number of observations in the first-stage regression increases, the estimates will tend to their true values, so that y^0_{Gc} and y^1_{Gc} (the corrected budget shares and unit values, respectively) will tend to the true cluster means. For equations 3.15 and 3.16:

$$\begin{aligned} y^0_{Gc} &= \alpha^0_G + \sum \Theta_{GH} \ln p_{Hc} + f_{Gc} + u^0_{Gc} \qquad (3.30) \\ y^1_{Gc} &= \alpha^1_G + \sum \psi_{GH} \ln p_{Hc} + u^1_{Gc} \qquad (3.31) \end{aligned}$$

where u^0_{Gc} and u^1_{Gc} are the cluster means of errors from equations 3.15 and 3.16.

The matrix of price effects Θ could be estimated by regressing each y^0_{Gc} on the matrix of corrected prices y_{Gc} if the matrix Ψ were an identity and if the cluster means u^0_{Gc} and u^1_{Gc} were zero. Given that, in most cases, quality effects indeed exist and that cluster samples are never large enough to neglect averages of measurement errors there is need to correct for them. The method Deaton uses is the standard errors in variable model. It allows both for the measurement error in the prices, and any possible correlation between the measurement errors price and share equations.

First define the variance and covariance matrices corresponding to equations 3.30 and 3.31:

$$q_{GH} = cov(y^0_{Gc}, y^0_{Hc}), \qquad s_{GH} = cov(y^1_{Gc}, y^1_{Hc}), \tag{3.32}$$

$$r_{GH} = cov(y^0_{Gc}, y^1_{Hc}). \tag{3.33}$$

By definition, the OLS estimator would be $S^{-1}R$, a feasible version of which is $\tilde{S}^{-1}\tilde{R}$, where the tildes show that the covariances are evaluated using the estimates in 3.28 and 3.29. There is, however, a problem with the variance-covariance matrix S. It overestimates the variance-covariance matrix of the true prices because it includes the effects of the measurement error in 3.31. In the same way, R is contaminated by any covariances in the measurement error between the two equations. These problems can be overcome by using the variances and covariances of the errors estimated from the first stage regressions to make the corrections. Denoting the residual variances and covariances estimates $\tilde{\sigma}^{00}_{GH}, \tilde{\sigma}^{11}_{GG}$ and $\tilde{\sigma}^{11}_{GG}$ in matrix form as $\tilde{\Sigma}$, $\tilde{\Omega}$, and $\tilde{\Gamma}$, and their corresponding population limits as Σ, Ω, and Γ, then from 3.30 and 3.31:

$$S = \Psi M \Psi' + \Omega N_+^{-1}, \;\; R = \Psi M \Theta' + \Gamma N^{-1}, \tag{3.34}$$

where M is the unobservable variance covariance matrix of the true price vector, $N_+^{-1} =$ plim $C^{-1} \sum_c D(n_c^+)$, $D(n_c^+)$ is a diagonal matrix formed from the n_c's. Measurement error is eliminated in OLS by subtracting the second terms on the right hand side of each of the equations in 3.34. This gives the estimator:

$$\tilde{B} = (\tilde{S} - \tilde{\Omega}\tilde{N}_+^{-1})^{-1}(\tilde{R} - \tilde{\Gamma}\tilde{N}^{-1}) \tag{3.35}$$

where $\tilde{N}_{+}^{-1}$ and $\tilde{N}^{-1}$ correspond to the sample averages instead of the probability limits. From equation 3.34, taking probability limits as the sample size goes to infinity while keeping cluster sizes fixed gives:

$$\text{plim } \tilde{B} = B = (\Psi')^{-1}\Theta'. \tag{3.36}$$

The above results have the following interpretation. If Ψ is the identity matrix, $\tilde{B}$ converges to the transpose of the matrix of price responses Θ, which would be desirable. On the other hand, if $\Psi \neq I$, then B is all that can be identified from the data alone and further theory would be required to get beyond this point. Looking at equation 3.35 it is clear that in the absence of measurement error, Ω and Γ are equal to zero , and the estimator, $\tilde{B}$, reduces to the OLS estimator as expected. Even if these matrices were not zero, it may be argued that large cluster sizes would make post-multiplying diagonal matrices so small that again the result would approach the OLS estimator. In such a scenario, averaging over clusters is enough to remove the measurement error and the price response matrix can simply be estimated by OLS once the expenditure and demographic effects have been removed at the first stage. Deaton's procedure, however, takes a more general view and allows for the possibility that measurement error may be sufficiently severe, or if cluster size is small enough, so that even averages are contaminated. To support this view he alludes to the fact that cluster sizes are often in single figures and that the number of purchases of a given good will be small indeed. The standard OLS variance-covariance matrix formulae, have to be modified for the errors-in-variables case. Deaton [8] shows a detailed approach to the modification, however, here, only the final result is shown:

$$V\{\text{vec}(\tilde{B})\} \simeq C^{-1}\left(P'HP \otimes A^{-1}JHJ'A^{-1}\right) + C^{-1}(P'HJ'A^{-1} \otimes A^{-1}J\Lambda J'A^{-1}K) \tag{3.37}$$

where $A = (S - \Omega N_{+}^{-1})$, $J = (O_N \mid I_N)$, and $P' = (I_N \mid -B')$. The matrices H and Λ derive from the variance covariance matrices of the measurement errors and the data according to:

$$H = \begin{pmatrix} Q & R' \\ R & S \end{pmatrix}, \qquad \Lambda = \begin{pmatrix} \Sigma & \Gamma' \\ \Gamma & \Omega \end{pmatrix}, \tag{3.38}$$

K is the $2N^2x2N^2$ commutation matrix; it is the matrix of ones and zeroes with the property that $Kvec(A) = vec(A')$ for an arbitrary conformable matrix A. A shortcoming in 3.37 is that it ignores the sampling variability of the first-stage estimates. It has, however, proven accurate in other applications [9].

The matrix B, along with first stage results, provides most of what is needed within the context of the data. However, to express the results in terms of the matrix of price elasticities, E, we turn to further theoretical considerations. To disentangle the combined effects of price and quality on unit values expressed in B, Deaton applies the price-quality model that expresses Ψ in terms of the total expenditure elasticities of quality. He uses equations 3.20 and 3.21 to eliminate the matrix of price elasticities, creating a relationship between Ψ and Θ. Noting that equation 3.36 also links Ψ and Θ with the estimated matrix B, then both Θ and Ψ, and thus the matrix of price elasticities E, are derived from the estimated parameters. Thus

$$\Theta = B'\{I - D(\xi)B' + D(\xi)D(w)\}^{-1} \tag{3.39}$$

$$E = \{D(w)^{-1}B' - I\}\{I - D(\xi)B' + D(\xi)D(w)\}^{-1}. \tag{3.40}$$

Estimates of Θ and E are then computed from 3.39 and 3.40 by using the first and second stage estimates. The vector w consists of mean budget shares and ξ is as defined in equation 3.23. The methodology of deriving standard errors of E is a very rigorous undertaking and is thoroughly treated in [8]. This not being the main thrust of this study, only the final formulations are shown here:

$$V\{vec(E')=\{(D(w)^{-1}+ED(\xi))\otimes G\}V\{vec(B)\}\{(D(w)^{-1}+D(\xi)E')\otimes G'\} \tag{3.41}$$

$$G=\{I-D(\xi)+D(\xi)D(w)\}^{-1}. \tag{3.42}$$

3.7 Data

3.7.1 Data Source and Sample Size

The data used in this study was collected in the Uganda National Integrated Household Survey (IHS) conducted between March ,1992 to March, 1993 by the Social Dimensions of Adjustment (SDA) project of the Ministry of Finance and Economic Planning of the Government of Uganda with World Bank support. The IHS was more comprehensive than the HBS conducted earlier in 1989-90. It covered the whole country including the five districts in the Northern Region and two districts in the Eastern region that were not covered in the HBS because of insecurity. A total of 9929 households were selected for the survey using a stratified two-stage sampling design, but only 9921 were actually surveyed including 448 substitutes.

The list of Enumeration Areas (EAs) prepared for the 1991 Population Census, along with maps and data on households and populations were used as the basic sampling frame. The EAs were treated as the first stage units and the household lists as the second.

The actual survey was implemented over a period of 12 months in accordance to the IPNS design (Interpenetrating Network of Sub-Samples) to provide periodic independent estimates of seasonal variation, to eliminate seasonal effects in the overall estimates and to facilitate computation of standard errors of estimates.

3.7.2 Questionnaires

Several different questionnaires were used to cover the different aspects of the survey. The questionnaires addressing household demographics and food consumption provided the bulk of the data used in this study and are contained in Appendix A. Households were interviewed on the different food items and quantities consumed over periods of 7 and 30 days and on the total expenditure made on each of these items respectively. Households also had to indicate their food sources as either home grown, purchased, or obtained as gifts. The specific household member making the purchase was also noted.

3.7.3 Data Manipulation

Household food consumption data of all 9921 households surveyed were compiled in one large database file. In its raw form, this household consumption data posed one major problem: quantities of food items consumed were often recorded in highly diverse and irregular local measurement units such as tins, heaps, glasses, bottles and baskets. Much as these measurements may be confounding, they are quite uniform within their local environments. Using this knowledge, corresponding metric measurements were substituted for the local ones.

Another significant problem was the fact that some of the food items were reported eaten in different forms. Maize, for example, was eaten green on-the-cob or in processed flour form. Conversion factors supplied by the Department of Statistics in the Ministry of Finance and Planning were used to convert intra-food forms into a single uniform form for each food type.

Once all food consumption was converted into acceptable metric measurements and uniform food types, households were then grouped by region and by urban and rural locations. Uganda is made up of four regions: Central, Eastern, Western and Northern regions. Each of these had its surveyed households subdived into rural and urban groupings. A total of eight groupings were obtained this way.

3.7.4 Computation of Model Variables

While the original data had consumption information on a comprehensive list of foods eaten all over Uganda, this study confines itself to six main food staples, namely: matoke, sweet potatoes, cassava, maize, millet and beans. Beef was added to these to elicit household demand responses to a luxury good.

Budget shares w_{Gic}

Basic household consumption expenditure data collected in the SDA survey, recorded both the quantity of a given staple consumed by the household over the last 30 days and its value. The foods consumed were categorized as coming from (1) home produced stocks, (2) market purchases, and (3) out of free collection and gifts.

The units of quantity recorded varied greatly. They included regular measures such as kilograms and liters, and irregular ones such as tins, bottles, baskets and heaps. The irregular measures were converted to regular ones with the help of conversion tables drawn up during the survey. Total household quantities of each staple food consumed over the last 30 days where then computed.

In the case of cassava the conversion process was further complicated by the fact that while it is both consumed in fresh and flour form, the data in SDA made no such distinction. Based on the fact that cassava flour costs more per kg than fresh cassava, unit values were used to identify reported quantities as either consisting of fresh cassava or cassava flour. In the next step fresh cassava was converted to the flour equivalent in weight, and the total quantity of cassava consumed by each household over the last 30 days was computed.

Outliers

The unit cost of food staples differs from region to another. Possible causes include climate, cultural tastes, and transportation costs among others. Unit values were used to delineate plausible ranges of unit costs of food staples in each region. Records with unit values falling outside of these ranges were considered unacceptable outliers and were deleted (see Table 3.1).

The remaining observations were used to calculate total household food expenditure and total household quantity of a given food staple consumed over a period of 30 days. As in Deaton's [9] methodology, zero consumption, consumption from own-produced stocks and market purchases were treated with the same weight in the computations.

Household food budget shares

Household food budget shares for each of the seven major food staples consumed by the household were computed by dividing total household quantity of a staple consumed over a 30 day period by the grand total spent by the household on all the seven staples over this period.

Table 3.1: Ranges of Acceptable Unit Values (UShs. per kg.)

	Central	East	North	West
RURAL				
Matoke	-	-	<200	<200
Sweet potatoes	-	>20	<140	10-300
Cassava	100-500	100-500	50-500	100-600
Maize	100-600	100-400	50-600	100-600
Millet	100-600	>150	50-400	>90
Beef	500-1500	<1500	400-1500	400-1200
Beans	100-700	-	65-600	100-600
URBAN				
Matoke	-	-	-	<300
Sweet potatoes	-	<300	>14	>20
Cassava	100-600	100-600	<500	<500
Maize	<500	100-400	<500	<500
Millet	>200	150-700	150-500	150-500
Beef	<1600	500-1500	<1200	>1200
Beans	200-800	150-700	200-800	200-800

Per capita household food expenditure

Per capita household expenditure on food for each household was obtained by dividing the annualized total household food expenditure by the household size. Annualized total household food expenditure was made up of three components: the imputed value of food consumed from home stocks, the value of purchased food, and the imputed value of food gifts. It is important to point out that the proportion of imputed food expenditure from home stocks and gifts in total food expenditure tend to be high in rural households. Allowance for this inconsistency is made by treating rural and urban sectors separately in the analysis.

3.7.5 Demographic Variables

When the unit of demand is at the household level, households in the same income group facing similar prices but different demographics (size, sex, education and age) are likely to exhibit different expenditure patterns. The inclusion of demographic variables in food demand analysis helps reduce bias in the estimated coefficients of the more directly policy-relevant income and price variables[20, 24]

In a similar fashion to Deaton's [9] methodology, the demographic variables included in this study are the household size, age-sex ratio, and level of education of the head of the household.

Household size

This was simply a count of the members constituting a household. A household was defined as a group of people living and eating together. Homesteads in Uganda take on different structures from one region to another. In some regions several houses/huts constitute a homestead. For as long as all members of the homestead ate together, they were defined as one household. If on the other hand older sons of the homestead dined separately with their new families they were considered as separate households.

Age-sex ratio

To compute this variable, all households were grouped into 10 major age-sex groups. The first two groups consisted of both male and female household members aged 0-4 and 5-9. The rest of the eight groups were one for each sex for ages 10-19, 20-44, 45-64, and 65 and over. These groupings were adopted directly from reports of SDA survey showing the distribution of household population by age and sex in the various regions of Uganda [25] (see Appendix C).

The age-sex ratio was then computed by dividing the number of household members falling in a given age-sex group by the overall household size.

Education level

Formal education in Uganda may be divided into three major groupings: (1) Primary education; made up of seven grade levels, (2) Secondary education; consisting of an Ordinary Level (O'level) of four classes and an Advanced Level (A'level) of two classes, (3) post-secondary; consisting of universities, polytechnics and teacher training colleges.

Primary education consists of seven classes from primary one to primary seven (P. 1 to P. 7). At the end of P. 7, students are required to sit an exit exam. Those who successfully pass the exit exam are eligible for admission to the O'level part of the Secondary school system or as a second option, post-primary vocational colleges.

Students in S. 4, sit O'level exit exams in at least 8 different subjects. Successful candidates are then eligible for admission to the A'level part of the Secondary system where they specialize in course combinations of either Arts or Sciences. Students who pass O'level exit exams but fail to gain admission to the A'level have the option of joining post-secondary vocational schools such as teacher training colleges.

In the final year of A'level, S. 6 students sit university entry exams. Successful students, later, gain admission to one of several universities in the country. Makerere University being the oldest, largest and more prestigious takes the cream of the crop. Students who are not accepted by the universities may gain admission to polytechnical colleges.

In the study, education is treated as one of the decision variables in the consumption demand of food staples. Households benefiting from an education gain exposure to balanced diets and foreign consumption patterns that then influence their local consumption decisions. It is assumed here that the head of the household makes these consumption decisions and, hence, it his/her level of education that is considered. But perhaps a better indication would be the education level of the wife/mother in households with either.

The education level of the head of the household is categorized as either (1) primary seven and below (2) beyond P. 7 but no more than S. 6, or (3)beyond S. 6. Each of these categories is represented by a dummy variable in equations 3.15 and 3.16. The last category is used as the base dummy and is dropped during regression. The categorization was based on SDA survey results in which over 72 percent of all heads of households were found to have had either no formal education or to have only gone up to P. 7. Slightly over 26 percent went beyond P. 7 and either attended secondary school (both O and A'level) or received specialized training in post-primary institutions. Only a small percentage of 0.5 had bachelor degrees and higher (see Table 3.2).

3.8 Empirical Estimation of the Model

Once the variables were computed from the household survey data collected in the SDA, they were assembled to conform to equations 3.15 and 3.16. Estimation was carried out in two stages. The first-stage, within-cluster regressions were comprised of two equations for

Table 3.2: Education Level of Heads of Households and Average Household Size in Uganda by Gender

	Male headed		Female headed		Total	
Education level (1)	% (2)	Avg. size (3)	% (4)	Avg. size (5)	% (6)	Avg. size (7)
No education	22.1	4.5	54.3	4.0	30.5	4.3
Attended P.7 and below	46.7	5.0	30.2	4.1	42.4	4.8
Beyond P.7 but no more than S.4	19.4	5.4	10.0	4.5	16.9	5.3
Completed specialized training/certificate/diploma	6.1	4.8	1.7	4.4	4.9	4.5
Beyond S.4 but no more than S.6	5.1	5.6	3.6	3.8	4.8	5.3
Completed Bachelor's degree and beyond	0.6	5.8	0.2	6.7	0.5	5.9

each of the seven food staples for each of the four regions (Central, East, North and West) in both an urban and rural setting. In all, a total of 112 regressions were run to generate the first-stage parameter estimates.

Two alternative methods of estimation were available in the first-stage. One approach is that standard OLS could be applied directly to the equations taking care to include a dummy variable for each cluster to account for the cluster fixed effects. The second methodology offered an equally acceptable but much easier alternative of subtracting cluster means from all variables in equations 3.15 and 3.16, and then running standard OLS on the resulting deviations from the cluster means. The second methodology was used in this study.

The removal of cluster means eliminates the intercept term, the fixed effects and invariant prices resulting in the following formulations

$$(w_{Gic} - w_{G.c}) = \beta_G^0(\ln X_{ic} - \ln X_{\cdot c}) + \gamma_G^0 \cdot (z_{ic} - z_{\cdot c}) + (u_{Gic}^0 - u_{G\cdot c}^0), \tag{3.43}$$

$$(\ln v_{Gic} - \ln v_{G\cdot c}) = \beta_G^1(\ln X_{ic} - \ln X_{\cdot c}) + \gamma_G^1 \cdot (z_{ic} - z_{\cdot c}) + (u_{Gic}^1 - u_{G\cdot c}^1), \tag{3.44}$$

where the notation ‘$\cdot$’ represents means over all households in a given cluster c. Parameter estimates obtained using this alternative methodology are fully efficient, although, they require adjustment of their standard errors by a factor of $\sqrt[2]{\frac{(N-k)}{(N-k-C+1)}}$ where k is the number of regressors, N the sample size, and the C the number of clusters. This correction accounts for the $(C-1)$ degrees of freedom lost when the cluster means are subtracted from each variable. Deaton [9] found the correction factor to be quite small indeed (standard errors were found to increase by only about four percent). The correction was not applied in this analysis.

The resulting parameter estimates β^0, β^1, γ_G^0, and γ_G^1, showing the effects of total expenditure and demographic variables on budget shares and unit values are shown in Tables 4.22 to 4.25. The total food expenditure elasticities calculated according to equation 3.17 are also included. Residuals, resulting from the regressions, were used to estimate the variances and covariances of the measurement errors according to equations 3.25, 3.26 and 3.27 (Tables 4.26 to 4.29).

The estimated measurement error variances and covariances are used in the second stage of the estimation to correct the variance and covariance estimates of the mean budget shares and mean unit values. The mean budget shares and mean unit values are computed by netting out the effects of all right-hand side variables used in the first-stage regression weighted by their parameter estimates (see equations 3.28 and 3.29). The ratio of the covariance of corrected mean budget shares and mean unit values to the variance of corrected mean budget share provides an OLS estimate for the regression of mean budget shares on mean unit values (see equation 3.35).

The resulting $\tilde{B}$ estimates are used to compute the matrix of price elasticities, E, in equation 3.40 by theoretical linkage of quality and quantity elasticities. The accompanying standard errors (i.e. of the price elasticities) are derived from the variance covariance matrix of B according to equations 3.41 and 3.42.

3.9 Model Limitations

In self-criticism, Deaton [8] (pg. 302) points out that the model leaves a couple of unresolved issues.

1. It is very close to being exactly identified which makes it difficult to construct cross-checks that would give it more credibility.
2. While it gives plausible demand elasticities better justification would come from comparing results with those obtained using direct market prices.
3. The inclusion of zero observations in the Engel formulation of equation 3.15 makes it difficult to assume linearity.

Other criticism of Deaton's methodology come from the way it aggregates quantities of food items by summing the reported number of kilos purchased in each food category. Nelson [18] contends there is a problem with this method if the goods in the group are heterogeneous. There is then the likelihood there exists not one elasticity, but possibly as many physical quantity elasticities as there are dimensions in which to measure the good.

CHAPTER 4
RESULTS AND DISCUSSION

4.1 Introduction

Two sets of results are presented here. The first set is an exposition of mostly descriptive results compiled from survey reports contained in three volumes that were published by the department of statistics in the Ministry of Finance. The aim here is to outline demographic and consumption patterns that existed in different regions during the course of the survey. These differences are later used in offering plausible interpretations to the results arising from the model.

The second set of results arise from the application of Deaton's demand model to cross-sectional household consumption data collected in the SDA survey. These results show the impact of household demographic factors, income and price changes on the demand for food staples in the four major regions of Uganda. The terms household income and household expenditure will be used interchangeably. Household income includes all sorts of transitory (positive or negative) components such as wages received from off farm employment. However, total expenditures are under the household's control and make a better proxy for the household's permanent income. Besides variable choice being limited by the paucity of income data in budget surveys, static demand theory also defines the dependent variable as total expenditure and not as disposable income (which includes savings) [19, 13]. In estimating the model, household per capita expenditure on food is derived from annualized monthly household food expenditure. This procedure is justified by the assumption of weak separability. This implies that the demand for food staple G in the food group can be expressed as a function of the prices in and the budget allotment to that food group only. The group then interacts with other groups or total expenditure through its budget allotment [19].

Table 4.1: Descriptive Rural Household Statistics Computed from Survey Data (March '92 to March '93)

	RURAL			
	Central	East	North	West
Household Size	4.5	4.9	5.1	5
Sex Ratio (M/F)	1.01	0.95	0.95	0.99
Monthly Household Expenditure (Shs.)	54186	47125	38297	46920
[a]Monthly Household Food Expenditure (Shs.)	32937	27828	25311	33559
[b]Share of Food in Total Expenditure	62.83	64.27	66.71	43.15
Percentage of Expenditure Devoted to:				
Matoke	15.6	9.1	0.8	25.8
Sweet Potatoes	11.3	10.4	6.8	12.3
Cassava	13.1	12.8	13.8	7
Corn	10	9.5	7	4.8
Millet	1.1	6.8	5.2	5.3
Beef	5.8	5.6	3.5	4.6
Beans	7	4.1	8.4	12.1

Source: Ministry of Finance and Economic Planning (Uganda).

[a] Figures were calculated from household expenditure summaries contained in the final survey reports published by the Statistics Department in the Ministry of Finance of Uganda.

[a,b] These figures exclude beverages, tobacco and foods consumed in hotels and restaurants.

Table 4.2: Descriptive Urban Household Statistics Computed from Survey Data (March '92 to March '93)

	URBAN			
	Central	East	North	West
Household Size	4	4	4.6	3.9
Sex Ratio (M/F)	0.93	0.98	0.84	1
Monthly Household Expenditure (Shs.)	198155	79980	73081	72443
[a]Monthly Household Food Expenditure (Shs.)	55263	38953	39783	37972
[b]Share of Food in Total Expenditure	43.15	55.34	54.84	53.51
Percentage of Expenditure Devoted to:				
Matoke	16.1	7.5	1.2	20.2
Sweet Potatoes	5.3	4.5	4.5	6.5
Cassava	5.7	8.1	11.9	4.8
Corn	6.9	8.3	10.3	5.6
Millet	0.7	1.7	1.6	1.4
Beef	8.3	8.3	10.3	8.0
Beans	3.7	3.7	9.3	7.8

Source: Ministry of Finance and Economic Planning (Uganda).

[a] Figures were calculated from household expenditure summaries contained in the final survey reports published by the Statistics Department in the Ministry of Finance of Uganda.

[a,b] These figures exclude beverages, tobacco and foods consumed in hotels and restaurants.

4.2 Descriptive Results

Preliminary results from computation and rearrangement of SDA data reports are contained in Tables 4.1 and 4.2. These tables contain statistics on household size, gender composition, periodic expenditures and household budget shares of major food staples in Uganda.

4.2.1 Household Size and Sex Ratio

As shown in Table 4.1, rural household sizes are fairly similar across regions. They range from 4.5 in the central region to 5.1 people per household in the northern region. The east, north and west had, comparatively, similar household sizes.

Urban household sizes were fairly similar across regions but smaller than their rural counterparts (Table 4.2). With the exception of rural-central and urban-west regions, households in all other regions were predominantly composed of female members. The sex ratio (Male/Female) at 0.84 was lowest in urban north. This may be attributed to the civil strife that has continued to afflict this area to this day.

While a large household size increases the household's demand for food, services and other resources, it can be a blessing in disguise by implying the availability of more productive labor.

4.2.2 Household Expenditures

All regions showed urban monthly household expenditures far exceeding those of rural households. The central region eclipsed all other regions in this category. These figures are helpful in identifying the poorest regions of the country.

Rural north comes off as being the poorest region followed by rural east, west and central. Among urban regions the west ranks last in poverty followed by the north, the east and finally, the central region. The urban results are a little surprising showing the west being the poorest. The rural west is the most important source of matoke and dairy products.

Rural households devoted at least 60 percent of their expenditures on food compared to about 50 percent by urban households. As expected, the central region being home to the highest total expenditure households posted the lowest share of household expenditure on food.

4.2.3 Food Budget Shares

Percentages of food expenditure devoted to different foods differed between urban and rural households and also across regions. In the rural regions starchy staples accounted for quite a large share of expenditure on food. Beef is regarded as a luxury item by most households. The results show that urban households devoted more of their food expenditure on beef compared to their rural counterparts. Given that absolute food expenditures on food are much greater among urban households, and that the beef price differentials are not that much different between rural and urban households, the results show beef is consumed on a much wider scale in the urban areas. Thus, beef, otherwise a major source of protein, is missing in most rural diets. This is confirmed by the World Bank report on Uganda [26] which observed that while a rough calculation of the calorie equivalent of the food available per capita indicated about 3,420 calories available per person, the average food basket was very low in protein.

4.2.4 Food Consumption Patterns

The food budget shares in Tables 4.1 and 4.2, along with the regional per capita consumption figures in Table 4.3, offer an insight to the different food consumption patterns that exist across the regions.

Table 4.3: Regional Per Capita Consumption 1992/93 (Kg per head)

Crop	Central	Eastern	Northern	Western	Uganda
Matoke	220.0	142.0	22.5	315.0	207
Sweet Potatoes	82.0	104.0	63.0	97.0	80.0
Cassava	128.0	142.0	148.0	85.0	125.0
Corn	22.2	24.1	16.9	16.4	22.5
Millet	5.6	21.5	17.8	20.3	16.3
Beans	19.2	19.5	15.3	22.1	19.5

According to the per capita consumption figures, the western region had, by far, the highest consumption of matoke. It was followed by the central region where matoke is traditionally the main staple. The eastern region came in third and the north last. It is quite clear that matoke is not widely eaten in the north. Instead the north depends mainly on cassava and sweet potatoes, and to a lesser extent, maize and millet. This is in sharp contrast to years preceding the 1980s when millet and sorghum were immensely popular staples in this region. Cassava is a universally important food crop across regions. The main attraction with cassava lies in its important role as a famine food. It can be harvested over time and when not needed, can be left unharvested in the ground for long periods of time. Given minimal and often inefficient local food storage methods, cassava offers an efficient and cost effective alternative. Beans and maize were eaten in about equal amounts in all regions.

4.3 Variations in Regional Food Prices

Tables 4.4 and 4.5 show regional variations in food prices in rural and urban sectors respectively, based on SDA survey reports. On average food prices are highest in the Central region followed by the East, West and North. This pattern closely mirrors the distribution of regional household poverty in section 4.2.2. Central region households have the highest per capita food expenditures and the North, the least. Unfortunately, it is also the northern and north-eastern regions that are most vulnerable to food insecurity. This is one of the reasons why households in these regions may go hungry in the midst of plenty in other regions.

Table 4.4: Regional Rural Food Price Variation.

		Rural Average Prices			
Goods	Unit of Quantity	Central	Eastern	Western	North
[a]Matoke	Bunch-Medium	1848	1298	1475	843
[b]Maize Flour	Kg	477	298	236	N.R.
Cassava	Heap (2-3kg)	352	255	150	122
Sweet Potatoes	Heap (2-3kg)	358	157	156	111
Beef	Kg	958	1063	831	798
Beans (dry)	Kg	377	355	286	201

Source: Report on the Uganda National Integrated Household Survey 199293. World Bank/UNDP Project UGA/91/R02SDA Survey Statistics Department, Ministry of Finance and Economic Planning.

[a] In the northern region, matoke is relatively cheap due to low demand.

[b] Median prices for maizegrains were presented instead because of the presence of a few outliers.

Table 4.5: Regional Urban Food Price Variation.

		Urban Average Prices			
Goods	Unit of Quantity	Central	Eastern	Western	North
[a]Matoke	Bunch - Medium	2929	3390	1475	843
[b]Maize Flour	Kg	454	373	382	475
Cassava	Heap (2-3kg)	382	236	206	155
Sweet Potatoes	Heap (2-3kg)	444	230	211	175
Beef	Kg	1147	1288	937	871
Beans (dry)	Kg	423	413	327	474

Source: Report on the Uganda National Integrated Household Survey 199293. World Bank/UNDP Project UGA/91/R02SDA Survey Statistics Department, Ministry of Finance and Economic Planning.

[a] In the northern region, matoke is relatively cheap due to low demand.

[b] Median prices for maizegrains were presented instead because of the presence of a few outliers.

Food prices are much lower during the harvest period compared to the overall average price recorded during the survey period(March 1992 - March 1993) (see Table 4.6). Price variations were greatest in the central region followed by the west, east and then north. That harvest periods differ from one part of the country to another is a mitigating force in dampening seasonal price variation.

Table 4.6: Observed Price Differences Between Survey and Harvest Periods in the Four Regions of Uganda.

Goods	Unit of Quantity	Central	Eastern	Western	Northern
Matoke	BunchMedium	750	545	562	41
Maize Grains	Tin (20 liters)	500	1000	1500	0
Millet	Kg	100	78	104	37
Cassava	Tin (20 liters)	1232	542	835	388
Sweet Potatoes	Tin (20 liters)	944	295	545	200
Beans	Tin (20 liters)	2002	1957	2575	1294

Source: Report on the Uganda National Integrated Household Survey 199293. World Bank/UNDP Project UGA/91/R02SDA Survey Statistics Department, Ministry of Finance and Economic Planning.

4.3.1 Regression of Unit Values on Dummies

Deaton's methodology is dependent on the presence of spatial price variation to estimate the demand responses [6, 9]. Using the urban central region as the base dummy, unit values were regressed on the dummy variables associated with the remaining seven regional rural and urban sectors. The results show how prices vary between regions and are contained in Table 4.7.

The results show pronounced inter-regional food price differences. Apart from beef in rural east and beans in urban-east, all regional price means were lower than those in the base variable, urban central.

Table 4.7: Regression of Unit Values on Regional Dummies in Both Urban and Rural Sectors.

	RURAL SECTOR				URBAN SECTOR		
	CENTRAL	EAST	NORTH	WEST	EAST	NORTH	WEST
Matoke	-36	-39	-85	-68	-12	-53	-45
	(2.9)	(4.8)	(6.7)	(3.4)	(3.6)	(6.3)	(3.0)
Sweet Potatoes	-16	-107	-124	-113	-35	-64	-34
	(3.4)	(4.9)	(3.7)	(3.8)	(3.9)	(4.2)	(3.5)
Cassava	-16	-107	-124	-113	-91	-93	-96
	(8.5)	(12.4)	(8.6)	(9.2)	(9.0)	(10.1)	(10.0)
Maize	-6	-77	-82	-69	-43	-122	-47
	(6.2)	(10.3)	(8.1)	(7.1)	(9.3)	(11.9)	(8.3)
Millet	15	-87	-199	-116	-44	-160	-38
	(15.7)	(22.4)	(13.5)	(14.8)	(16.6)	(16.9)	(16.7)
Beef	-129	48	-266	-228	138	-206	-140
	(9.9)	(14.3)	(12.0)	(10.1)	(12.7)	(13.5)	(12.0)
Beans	-29	-67	-106	-111	3	-8	-33
	(9.5)	(14.2)	(9.0)	(10.2)	(11.3)	(11.0)	(11.9)

The values in parenthes are standard errors.

4.4 First Stage Within-Cluster Regression Results

The first-stage within-cluster parameters estimates reported in this section were obtained by applying OLS to the budget share and unit value equations net of variable cluster means (see equations 3.43 and 3.44 in section 3.8). The estimation was done with SAS.

Tables 4.8 to 4.21 contain age-sex ratio and education parameter estimates. There are altogether 14 tables, one for each food staple in both rural and urban sectors. Tables 4.22 to 4.25 show coefficients of the logarithms of household per capita expenditure and of total household size for both the budget share and unit value equations, and also include the calculated total elasticity of expenditure. Tables 4.26 to 4.29 contain error measurement variances and covariances, and measures of average sample cluster sizes.

4.4.1 Age-Sex Ratio and Education Coefficients

The age-sex ratio parameter estimates were mostly not significant. In the few cases they turned up significant, they were of small magnitude and carried a negative sign suggesting that those households with particular high age-sex ratios will spend less on the food staple *ceteris paribus*. A positive sign, on the other hand, indicates more expenditure on the relevant food staple. The rural central results for matoke had the single most concentration of significant cases, a total of 4 in all. Three of these were negative and small in magnitude and occurred among male groups ages 20-44, 45-64 and equal to or greater than 65. Other than the 65 and over age group, the other two groups represent economically active adults who in most cases would be involved in farming and would, hence, cater adequately for their matoke needs reducing the need to spend on it. The other significant but positive result occurred in the male group 10-19. Usually, this is considered an economically viable group in Uganda and would have been expected to have the same effects on the matoke budget share as the other three. The result instead calls for increased expenditure on matoke suggesting dependency of this age-sex group.

The education coefficients were all very small in both the rural and urban locations showing minimal influence of education in household food demand decisions. As expected the rural education coefficients were much smaller than those of the relatively more educated households in the urban sectors. Only 5 rural education coefficients were significant with respect to budget share but a total of 15 were with respect to the log of the unit value. The ratio is about the same in the urban sector results. This suggests a greater influence of education in the demand for food quality in the urban sector. In most of the cases (both budget share and unit value), education coefficients corresponding to the P.7 or less category (ED1) are larger than those of the >P.7 but <S.6 category. Budget share education coefficients are predominantly positive and those of the unit value predominantly negative.

Table 4.8: Rural Demographic Coefficients: Matoke.

	Central		East		North		West	
	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr
BUDGET SHARE								
AGSX1	0.01	0.06	-0.06	0.12	-0.01	0.03	-0.03	0.06
AGSX2	0.01	0.06	-0.02	0.14	0.00	0.03	-0.02	0.07
AGSX3	0.14	0.05	-0.11	0.10	-0.01	0.03	-0.06	0.07
AGSX4	-0.09	0.07	0.15	0.12	-0.03	0.03	-0.06	0.07
AGSX5	^{d}-0.13	0.04	-0.14	0.08	0.02	0.03	-0.06	0.05
AGSX6	-0.04	0.05	-0.14	0.08	-0.03	0.03	^{d}-0.14	0.06
AGSX7	^{d}-0.11	0.05	-0.12	0.11	0.01	0.03	0.02	0.07
AGSX8	0.11	0.07	-0.18	0.11	-0.02	0.03	-0.09	0.08
AGSX9	^{d}-0.16	0.06	0.10	0.20	^{d}-0.16	0.04	-0.03	0.10
ED1	0.01	0.01	0.02	0.02	0.00	0.00	^{d}0.03	0.01
ED2	-0.01	0.01	0.00	0.01	0.00	0.00	^{d}-0.02	0.01
UNIT VALUE								
AGSX1	-0.03	0.11	0.02	0.27	0.36	0.44	^{d}0.43	0.14
AGSX2	0.08	0.13	-0.33	0.37	0.74	0.43	0.14	0.18
AGSX3	0.17	0.12	0.04	0.20	0.23	0.43	0.06	0.19
AGSX4	0.10	0.13	0.45	0.24	0.11	0.32	0.09	0.17
AGSX5	0.13	0.09	-0.12	0.18	0.12	0.21	^{d}0.28	0.12
AGSX6	^{d}0.25	0.09	-0.29	0.18	-0.43	0.54	^{d}0.33	0.13
AGSX7	0.19	0.11	-0.11	0.22	0.53	0.59	-0.10	0.18
AGSX8	0.16	0.15	0.23	0.45	0.01	0.28	0.21	0.18
AGSX9	0.07	0.16	-0.55	1.02	-0.38	0.33	0.17	0.25
ED1	^{d}-0.09	0.02	^{d}-0.11	0.05	0.09	0.07	0.00	0.02
ED2	^{d}-0.04	0.01	-0.02	0.03	-0.02	0.04	-0.03	0.02

AGSX1 = Male and female household members aged 0-4.

AGSX2 = Male and female households members aged 5-9.

AGSX3 = Male household members aged 10-19.

AGSX3 = Male household members aged 10-19.

AGSX5 = Male household members aged 20-44.

AGSX6 = Female household members aged 20-44.

AGSX7 = Male household members aged 45-64.

AGSX8 = Female household members aged 45-64.

AGSX9 = Male household members aged $\geq$65.

AGSX10 = Female household members aged $\geq$65, selected as base dummy variable.

ED1 = Education level of head of household P. 7 or less.

ED2 = Education level of head household more >P. 7 but <S. 6.

^{d}Statistical significance at 5% level.

Table 4.9: Rural Demographic Coefficients: Sweet potatoes.

	Central		East		North		West	
	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr
BUDGET SHARE								
AGSX1	-0.03	0.06	0.03	0.06	-0.01	0.09	0.00	0.02
AGSX2	0.02	0.06	-0.06	0.07	-0.05	0.07	-0.02	0.02
AGSX3	-0.03	0.05	-0.06	0.05	0.09	0.08	0.02	0.03
AGSX4	-0.01	0.07	-0.03	0.06	-0.02	0.08	-0.03	0.03
AGSX5	-0.06	0.04	-0.02	0.04	-0.07	0.07	0.03	0.02
AGSX6	-0.04	0.05	-0.08	0.05	-0.11	0.07	0.00	0.02
AGSX7	-0.02	0.05	0.03	0.06	-0.12	0.08	-0.02	0.03
AGSX8	0.01	0.07	0.04	0.06	-0.12	0.07	0.04	0.03
AGSX9	-0.10	0.06	0.07	0.11	0.05	0.11	-0.04	0.04
ED1	^{d}0.04	0.01	0.00	0.01	0.01	0.01	0.00	0.00
ED2	0.00	0.01	0.01	0.01	0.00	0.01	0.00	0.00
UNIT VALUE								
AGSX1	-0.08	0.12	-0.58	0.32	0.26	0.21	0.07	0.19
AGSX2	0.05	0.14	-0.49	0.36	0.07	0.16	0.09	0.25
AGSX3	-0.05	0.14	0.25	0.23	-0.37	0.20	0.40	0.25
AGSX4	0.14	0.16	-0.43	0.25	0.28	0.19	-0.22	0.22
AGSX5	0.00	0.10	-0.16	0.20	0.08	0.14	0.04	0.16
AGSX6	0.05	0.10	-0.05	0.19	-0.15	0.17	^{d}0.46	0.20
AGSX7	0.02	0.12	-0.16	0.23	0.12	0.17	0.11	0.22
AGSX8	0.01	0.17	-0.34	0.29	-0.09	0.18	-0.15	0.25
AGSX9	0.01	0.19	0.65	0.96	-0.18	0.20	-0.12	0.25
ED1	^{d}-0.06	0.03	0.01	0.05	0.01	0.03	-0.03	0.03
ED2	0.00	0.02	-0.04	0.03	-0.02	0.02	0.01	0.02

AGSX1 = Male and female household members aged 0-4.

AGSX2 = Male and female households members aged 5-9.

AGSX3 = Male household members aged 10-19.

AGSX3 = Male household members aged 10-19.

AGSX5 = Male household members aged 20-44.

AGSX6 = Female household members aged 20-44.

AGSX7 = Male household members aged 45-64.

AGSX8 = Female household members aged 45-64.

AGSX9 = Male household members aged $\geq$65.

AGSX10 = Female household members aged $\geq$65, selected as base dummy variable.

ED1 = Education level of head of household P. 7 or less.

ED2 = Education level of head household more >P. 7 but <S. 6.

[d] Statistical significance at 5% level.

Table 4.10: Rural Demographic Coefficients: Cassava.

	Central		East		North		West	
	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr
BUDGET SHARE								
AGSX1	-0.04	0.03	-0.04	0.09	-0.01	0.05	0.04	0.03
AGSX2	-0.04	0.03	-0.11	0.11	0.05	0.04	-0.01	0.03
AGSX3	-0.01	0.03	0.02	0.08	0.01	0.05	0.00	0.03
AGSX4	0.05	0.04	[d]-0.19	0.09	0.01	0.05	[d]-0.10	0.03
AGSX5	0.02	0.02	-0.07	0.06	0.03	0.04	0.01	0.02
AGSX6	0.04	0.03	-0.08	0.07	0.03	0.04	-0.04	0.03
AGSX7	0.03	0.03	[d]-0.27	0.09	-0.02	0.05	-0.03	0.03
AGSX8	0.06	0.04	0.02	0.09	0.05	0.04	0.02	0.04
AGSX9	0.04	0.04	-0.27	0.16	0.02	0.06	-0.01	0.04
ED1	0.01	0.01	0.02	0.01	0.00	0.01	0.00	0.00
ED2	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00
UNIT VALUE								
AGSX1	-0.07	0.10	-0.36	0.25	-0.02	0.13	0.09	0.12
AGSX2	-0.10	0.11	-0.22	0.27	-0.18	0.11	0.09	0.14
AGSX3	[d]0.20	0.10	-0.03	0.16	0.03	0.13	0.12	0.15
AGSX4	0.16	0.10	-0.30	0.23	0.00	0.13	0.13	0.12
AGSX5	0.02	0.07	-0.11	0.13	0.07	0.12	-0.03	0.09
AGSX6	0.12	0.07	-0.27	0.14	-0.10	0.11	-0.00	0.10
AGSX7	0.12	0.08	[d]-0.56	0.20	-0.18	0.14	-0.16	0.17
AGSX8	0.11	0.15	-0.26	0.21	-0.05	0.12	-0.01	0.15
AGSX9	0.06	0.13	-0.60	0.64	0.14	0.21	0.47	0.29
ED1	[d]-0.05	0.02	0.01	0.04	-0.02	0.02	0.00	0.02
ED2	0.01	0.01	-0.01	0.02	-0.03	0.01	-0.01	0.01
XHHSZ	[d]0.16	0.07	-0.19	0.15	0.13	0.09	0.11	0.10

AGSX1 = Male and female household members aged 0-4.

AGSX2 = Male and female households members aged 5-9.

AGSX3 = Male household members aged 10-19.

AGSX3 = Male household members aged 10-19.

AGSX5 = Male household members aged 20-44.

AGSX6 = Female household members aged 20-44.

AGSX7 = Male household members aged 45-64.

AGSX8 = Female household members aged 45-64.

AGSX9 = Male household members aged $\geq$65.

AGSX10 = Female household members aged $\geq$65, selected as base dummy variable.

ED1 = Education level of head of household P. 7 or less.

ED2 = Education level of head household more >P. 7 but <S. 6.

[d] Statistical significance at 5% level.

Table 4.11: Rural Demographic Coefficients: Maize.

	Central		East		North		West	
	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr
BUDGET SHARE								
AGSX1	-0.07	0.05	-0.08	0.10	0.03	0.04	-0.04	0.04
AGSX2	-0.05	0.05	0.10	0.11	-0.03	0.03	-0.02	0.04
AGSX3	0.03	0.04	0.03	0.08	0.01	0.04	0.03	0.04
AGSX4	-0.04	0.05	[d]-0.20	0.09	-0.01	0.04	-0.02	0.04
AGSX5	0.01	0.03	0.12	0.06	[d]0.06	0.03	0.02	0.03
AGSX6	-0.05	0.04	-0.04	0.07	-0.02	0.03	0.02	0.04
AGSX7	0.03	0.04	0.09	0.09	-0.01	0.04	0.03	0.04
AGSX8	0.07	0.06	-0.01	0.09	0.04	0.03	-0.06	0.05
AGSX9	0.01	0.05	0.12	0.17	0.02	0.05	-0.03	0.06
ED1	0.00	0.01	0.01	0.01	0.01	0.00	0.01	0.01
ED2	0.00	0.01	0.00	0.01	-0.01	0.00	0.00	0.00
UNIT VALUE								
AGSX1	0.00	0.06	0.09	0.18	0.10	0.13	0.00	0.09
AGSX2	0.07	0.06	0.04	0.17	0.17	0.11	-0.08	0.10
AGSX3	0.02	0.05	-0.10	0.12	0.15	0.12	0.05	0.10
AGSX4	-0.02	0.06	-0.09	0.15	-0.23	0.15	0.01	0.11
AGSX5	-0.04	0.04	-0.18	0.10	[d]0.25	0.09	-0.01	0.08
AGSX6	0.00	0.05	-0.10	0.11	0.06	0.11	0.10	0.09
AGSX7	-0.04	0.05	-0.23	0.15	[d]0.22	0.11	0.09	0.11
AGSX8	0.05	0.08	[d]-0.37	0.17	0.20	0.12	0.05	0.11
AGSX9	-0.03	0.07	-0.04	0.65	0.06	0.17	-0.05	0.11
ED1	-0.01	0.01	[d]-0.05	0.03	[d]-0.02	0.01	-0.02	0.01
ED2	0.00	0.01	0.01	0.02	[d]-0.03	0.01	-0.01	0.01

AGSX1 = Male and female household members aged 0-4.

AGSX2 = Male and female households members aged 5-9.

AGSX3 = Male household members aged 10-19.

AGSX3 = Male household members aged 10-19.

AGSX5 = Male household members aged 20-44.

AGSX6 = Female household members aged 20-44.

AGSX7 = Male household members aged 45-64.

AGSX8 = Female household members aged 45-64.

AGSX9 = Male household members aged $\geq$65.

AGSX10 = Female household members aged $\geq$65, selected as base dummy variable.

ED1 = Education level of head of household P. 7 or less.

ED2 = Education level of head household more >P. 7 but <S. 6.

[d] Statistical significance at 5% level.

Table 4.12: Rural Demographic Coefficients: Millet.

	Central		East		North		West	
	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr
BUDGET SHARE								
AGSX1	0.00	0.01	-0.06	0.05	-0.06	0.03	0.00	0.02
AGSX2	-0.01	0.01	0.05	0.06	-0.03	0.03	-0.01	0.02
AGSX3	0.00	0.01	-0.06	0.039	0.00	0.03	-0.01	0.02
AGSX4	0.00	0.01	-0.03	0.048	0.04	0.03	0.01	0.02
AGSX5	0.01	0.01	-0.01	0.03	0.03	0.03	0.00	0.01
AGSX6	0.01	0.01	-0.01	0.04	0.02	0.03	0.00	0.02
AGSX7	0.00	0.01	-0.03	0.05	^{d}0.07	0.03	0.01	0.02
AGSX8	0.01	0.01	^{d}-0.11	0.05	0.03	0.03	0.00	0.02
AGSX9	0.00	0.01	-0.00	0.09	0.03	0.04	0.00	0.03
ED1	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00
ED2	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
UNIT VALUE								
AGSX1	-0.10	0.14	0.13	0.51	-0.23	0.16	0.09	0.17
AGSX2	-0.19	0.16	0.57	0.41	0.01	0.12	0.40	0.22
AGSX3	0.10	0.17	0.02	0.25	0.08	0.14	-0.04	0.25
AGSX4	0.11	0.18	-0.51	0.28	-0.05	0.13	-0.17	0.20
AGSX5	0.15	0.13	0.00	0.27	0.18	0.16	0.29	0.19
AGSX6	0.10	0.19	-0.13	0.24	-0.01	0.12	0.08	0.20
AGSX7	0.11	0.16	-1.07	0.95	-0.26	0.14	0.15	0.40
AGSX8	0.11	0.26	0.13	0.33	-0.16	0.13	-0.40	0.50
AGSX9	0.54	0.43	1.89	2.85	-0.01	0.17	-0.48	0.59
ED1	-0.02	0.04	0.10	0.09	-0.04	0.02	0.02	0.03
ED2	-0.01	0.02	-0.01	0.04	-0.01	0.02	-0.03	0.02

AGSX1 = Male and female household members aged 0-4.

AGSX2 = Male and female households members aged 5-9.

AGSX3 = Male household members aged 10-19.

AGSX3 = Male household members aged 10-19.

AGSX5 = Male household members aged 20-44.

AGSX6 = Female household members aged 20-44.

AGSX7 = Male household members aged 45-64.

AGSX8 = Female household members aged 45-64.

AGSX9 = Male household members aged $\geq$65.

AGSX10 = Female household members aged $\geq$65, selected as base dummy variable.

ED1 = Education level of head of household P. 7 or less.

ED2 = Education level of head household more >P. 7 but <S. 6.

^{d}Statistical significance at 5% level.

Table 4.13: Rural Demographic Coefficients: Beef.

	Central		East		North		West	
	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr
BUDET SHARE								
AGSX1	-0.03	0.04	0.03	0.12	-0.06	0.06	-0.08	0.05
AGSX2	-0.06	0.04	-0.03	0.15	-0.03	0.05	0.03	0.05
AGSX3	-0.02	0.03	0.15	0.10	-0.05	0.06	0.05	0.06
AGSX4	-0.04	0.04	-0.09	0.12	-0.03	0.06	0.00	0.06
AGSX5	0.02	0.03	0.08	0.08	-0.04	0.05	-0.04	0.04
AGSX6	-0.01	0.03	0.14	0.09	0.04	0.05	0.04	0.05
AGSX7	0.02	0.03	0.02	0.12	[d]0.11	0.06	-0.08	0.06
AGSX8	-0.01	0.04	0.02	0.12	-0.03	0.05	0.03	0.06
AGSX9	0.01	0.04	-0.27	0.22	0.02	0.08	-0.02	0.08
ED1	-0.01	0.01	-0.02	0.02	0.00	0.01	-0.01	0.01
ED2	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.01
UNIT VALUE								
AGSX1	0.00	0.04	-0.04	0.06	0.07	0.05	0.005	0.027
AGSX2	-0.05	0.04	0.01	0.07	0.02	0.04	0.023	0.029
AGSX3	0.01	0.04	[d]-0.14	0.05	-0.05	0.05	-0.024	0.032
AGSX4	0.00	0.04	[d]-0.12	0.06	0.02	0.05	-0.013	0.032
AGSX5	-0.01	0.03	-0.06	0.04	0.00	0.04	0.035	0.024
AGSX6	0.01	0.03	-0.06	0.05	0.01	0.04	0.018	0.028
AGSX7	0.06	0.03	-0.08	0.06	-0.01	0.04	0.012	0.034
AGSX8	0.01	0.05	[d]-0.16	0.08	0.02	0.05	0.049	0.037
AGSX9	0.00	0.05	-0.11	0.24	-0.12	0.07	-0.006	0.056
ED1	[d]-0.03	0.01	-0.02	0.01	-0.01	0.01	-0.004	0.004
ED2	[d]-0.01	0.00	0.00	0.01	0.00	0.01	-0.002	0.003

AGSX1 = Male and female household members aged 0-4.

AGSX2 = Male and female households members aged 5-9.

AGSX3 = Male household members aged 10-19.

AGSX3 = Male household members aged 10-19.

AGSX5 = Male household members aged 20-44.

AGSX6 = Female household members aged 20-44.

AGSX7 = Male household members aged 45-64.

AGSX8 = Female household members aged 45-64.

AGSX9 = Male household members aged ≥65.

AGSX10 = Female household members aged ≥65, selected as base dummy variable.

ED1 = Education level of head of household P. 7 or less.

ED2 = Education level of head household more >P. 7 but <S. 6.

[d] Statistical significance at 5% level.

Table 4.14: Rural Demographic Coefficients: Beans.

	Central		East		North		West	
	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr
BUDGET SHARE								
AGSX1	-0.03	0.02	-0.12	0.12	-0.08	0.06	0.02	0.03
AGSX2	0.03	0.02	-0.04	0.14	[d]0.15	0.06	0.05	0.03
AGSX3	0.01	0.02	-0.08	0.10	0.08	0.06	-0.02	0.04
AGSX4	0.01	0.03	-0.19	0.12	0.03	0.06	0.03	0.04
AGSX5	0.03	0.02	-0.03	0.08	0.10	0.05	0.04	0.03
AGSX6	0.02	0.02	-0.03	0.09	0.01	0.06	-0.02	0.03
AGSX7	[d]0.05	0.02	-0.14	0.11	0.05	0.06	-0.04	0.04
AGSX8	0.03	0.03	0.07	0.12	[d]0.13	0.05	0.02	0.04
AGSX9	-0.01	0.03	-0.12	0.21	0.02	0.08	0.02	0.05
ED1	0.00	0.00	0.03	0.02	0.01	0.01	0.00	0.00
ED2	0.00	0.00	-0.01	0.01	-0.01	0.01	0.00	0.00
UNIT VALUE								
AGSX1	0.11	0.09	0.00	0.18	-0.08	0.06	-0.01	0.11
AGSX2	0.02	0.10	-0.25	0.21	[d]0.15	0.06	[d]-0.28	0.14
AGSX3	0.03	0.08	-0.02	0.12	0.08	0.06	-0.17	0.14
AGSX4	0.17	0.11	[d]-0.39	0.18	[d]0.03	0.06	[d]0.24	0.12
AGSX5	0.01	0.06	0.02	0.12	0.10	0.05	0.12	0.10
AGSX6	0.06	0.07	-0.19	0.13	0.01	0.06	-0.01	0.10
AGSX7	0.05	0.08	-0.07	0.17	0.05	0.06	-0.02	0.12
AGSX8	0.05	0.13	-0.19	0.23	[d]0.13	0.05	0.21	0.17
AGSX9	0.17	0.11	0.62	0.51	0.02	0.08	0.01	0.15
ED1	-0.02	0.02	0.01	0.03	0.01	0.01	0.01	0.02
ED2	0.00	0.01	0.00	0.02	-0.01	0.01	[d]-0.03	0.01

AGSX1 = Male and female household members aged 0-4.

AGSX2 = Male and female households members aged 5-9.

AGSX3 = Male household members aged 10-19.

AGSX3 = Male household members aged 10-19.

AGSX5 = Male household members aged 20-44.

AGSX6 = Female household members aged 20-44.

AGSX7 = Male household members aged 45-64.

AGSX8 = Female household members aged 45-64.

AGSX9 = Male household members aged $\geq$65.

AGSX10 = Female household members aged $\geq$65, selected as base dummy variable.

ED1 = Education level of head of household P. 7 or less.

ED2 = Education level of head household more >P. 7 but <S. 6.

[d] Statistical significance at 5% level.

Table 4.15: Urban Demographic Coefficients: Matoke.

	Central		East		North		West	
	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr
BUDGET SHARE								
AGSX1	0.11	0.09	-0.06	0.09	-0.06	0.05	-0.17	0.11
AGSX2	0.03	0.10	-0.18	0.10	-0.03	0.04	-0.18	0.11
AGSX3	^{d}-0.21	0.08	0.03	0.07	-0.04	0.06	-0.14	0.08
AGSX4	0.03	0.08	0.01	0.08	-0.01	0.05	0.14	0.08
AGSX5	-0.03	0.05	0.01	0.05	0.02	0.03	0.00	0.06
AGSX6	0.03	0.06	0.04	0.06	-0.02	0.03	0.08	0.07
AGSX7	-0.15	0.09	-0.05	0.07	-0.07	0.06	0.04	0.11
AGSX8	0.05	0.18	0.05	0.09	^{d}0.13	0.05	^{d}0.29	0.12
AGSX9	0.33	0.18	-0.20	0.13	-0.05	0.08	0.16	0.16
ED1	-0.02	0.03	0.00	0.02	-0.01	0.01	0.02	0.02
ED2	0.00	0.01	0.00	0.01	-0.01	0.01	0.02	0.01
UNIT VALUE								
AGSX1	0.01	0.09	0.22	0.16	-0.20	0.30	-0.01	0.12
AGSX2	0.16	0.11	0.22	0.19	0.21	0.27	-0.07	0.12
AGSX3	0.03	0.08	-0.06	0.14	-0.73	0.48	-0.03	0.08
AGSX4	^{d}-0.29	0.08	-0.06	0.14	0.35	0.26	0.13	0.09
AGSX5	-0.07	0.06	-0.02	0.10	0.07	0.18	0.08	0.07
AGSX6	0.00	0.06	0.06	0.10	0.11	0.16	0.07	0.07
AGSX7	-0.17	0.10	-0.05	0.13	0.84	0.95	0.10	0.12
AGSX8	-0.08	0.25	0.18	0.16	-0.77	0.44	-0.06	0.16
AGSX9	-0.04	0.34	0.34	0.40	^{d}-2.28	1.02	0.30	0.29
ED1	^{d}-0.07	0.03	-0.03	0.04	^{d}-0.15	0.06	0.00	0.03
ED2	-0.01	0.01	^{d}-0.06	0.02	-0.07	0.04	-0.01	0.01

AGSX1 = Male and female household members aged 0-4.

AGSX2 = Male and female households members aged 5-9.

AGSX3 = Male household members aged 10-19.

AGSX3 = Male household members aged 10-19.

AGSX5 = Male household members aged 20-44.

AGSX6 = Female household members aged 20-44.

AGSX7 = Male household members aged 45-64.

AGSX8 = Female household members aged 45-64.

AGSX9 = Male household members aged $\geq$65.

AGSX10 = Female household members aged $\geq$65, selected as base dummy variable.

ED1 = Education level of head of household P. 7 or less.

ED2 = Education level of head household more >P. 7 but <S. 6.

^{d}Statistical significance at 5% level.

Table 4.16: Urban Demographic Coefficients: Sweet potatoes.

	Central		East		North		West	
	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr
BUDGET SHARE								
AGSX1	[d]-0.19	0.07	0.03	0.08	0.05	0.08	0.02	0.05
AGSX2	0.05	0.08	0.05	0.09	0.06	0.06	-0.07	0.05
AGSX3	-0.07	0.06	0.03	0.06	0.03	0.09	0.00	0.04
AGSX4	0.05	0.06	-0.08	0.07	-0.13	0.07	[d]0.08	0.04
AGSX5	-0.06	0.04	-0.09	0.05	0.00	0.05	0.01	0.03
AGSX6	-0.01	0.05	-0.06	0.05	-0.07	0.04	-0.01	0.03
AGSX7	-0.06	0.07	-0.08	0.06	-0.09	0.08	-0.02	0.05
AGSX8	-0.05	0.14	-0.09	0.08	-0.04	0.07	0.06	0.06
AGSX9	0.11	0.14	0.09	0.12	0.17	0.11	-0.02	0.07
ED1	0.02	0.02	[d]0.03	0.02	0.00	0.01	0.01	0.01
ED2	0.02	0.01	0.00	0.01	0.01	0.01	0.00	0.01
UNIT VALUE								
AGSX1	0.06	0.09	-0.11	0.23	-0.27	0.15	0.32	0.18
AGSX2	-0.01	0.11	[d]0.45	0.22	0.22	0.12	0.09	0.17
AGSX3	[d]-0.22	0.09	[d]-0.41	0.16	0.31	0.17	0.09	0.14
AGSX4	-0.16	0.10	0.09	0.17	0.08	0.13	0.17	0.13
AGSX5	-0.01	0.06	0.12	0.12	[d]0.24	0.10	[d]0.25	0.11
AGSX6	0.01	0.07	0.10	0.13	0.09	0.10	0.10	0.13
AGSX7	-0.03	0.09	0.13	0.16	-0.06	0.17	-0.11	0.20
AGSX8	-0.08	0.20	0.04	0.24	0.14	0.16	0.18	0.25
AGSX9	-0.71	1.10	0.43	0.27	0.10	0.35	-0.25	2.40
ED1	0.00	0.03	-0.01	0.05	0.05	0.03	-0.02	0.04
ED2	-0.02	0.01	0.01	0.03	-0.01	0.02	0.00	0.02

AGSX1 = Male and female household members aged 0-4.

AGSX2 = Male and female households members aged 5-9.

AGSX3 = Male household members aged 10-19.

AGSX3 = Male household members aged 10-19.

AGSX5 = Male household members aged 20-44.

AGSX6 = Female household members aged 20-44.

AGSX7 = Male household members aged 45-64.

AGSX8 = Female household members aged 45-64.

AGSX9 = Male household members aged ≥65.

AGSX10 = Female household members aged ≥65, selected as base dummy variable.

ED1 = Education level of head of household P. 7 or less.

ED2 = Education level of head household more >P. 7 but <S. 6.

[d] Statistical significance at 5% level.

Table 4.17: Urban Demographic Coefficients: Cassava.

	Central		East		North		West	
	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr
BUDGET SHARE								
AGSX1	0.01	0.05	0.03	0.12	-0.05	0.12	-0.06	0.06
AGSX2	-0.02	0.06	-0.10	0.13	-0.07	0.08	-0.08	0.06
AGSX3	-0.02	0.05	-0.07	0.10	-0.01	0.13	0.00	0.05
AGSX4	-0.05	0.05	-0.18	0.10	-0.11	0.10	0.00	0.05
AGSX5	-0.02	0.03	-0.01	0.07	-0.22	0.07	0.06	0.04
AGSX6	-0.07	0.04	-0.11	0.08	-0.06	0.07	0.08	0.04
AGSX7	-0.02	0.05	0.12	0.09	-0.28	0.12	0.13	0.06
AGSX8	-0.09	0.12	-0.07	0.12	-0.12	0.10	0.09	0.07
AGSX9	-0.05	0.11	-0.16	0.18	-0.06	0.17	0.18	0.09
ED1	0.03	0.02	0.01	0.02	0.02	0.02	0.01	0.01
ED2	0.01	0.01	0.02	0.01	0.00	0.02	0.01	0.01
UNIT VALUE								
AGSX1	-0.01	0.11	0.05	0.11	0.03	0.15	-0.24	0.18
AGSX2	0.25	0.15	-0.14	0.11	[d]-0.30	0.11	-0.19	0.16
AGSX3	-0.02	0.09	0.00	0.09	0.24	0.19	0.01	0.11
AGSX4	0.02	0.11	-0.01	0.09	-0.09	0.12	0.01	0.13
AGSX5	0.07	0.07	-0.01	0.07	-0.03	0.09	0.12	0.11
AGSX6	0.02	0.08	-0.06	0.07	0.03	0.09	-0.09	0.11
AGSX7	0.14	0.12	0.05	0.09	-0.03	0.15	-0.01	0.15
AGSX8	[d]-0.66	0.30	[d]-0.21	0.11	-0.26	0.13	0.14	0.27
AGSX9	-0.37	0.73	0.46	0.22	-0.14	0.26	-0.14	0.33
ED1	-0.03	0.03	0.00	0.02	0.00	0.02	-0.01	0.03
ED2	0.00	0.01	0.00	0.01	-0.01	0.02	0.02	0.02

AGSX1 = Male and female household members aged 0-4.

AGSX2 = Male and female households members aged 5-9.

AGSX3 = Male household members aged 10-19.

AGSX3 = Male household members aged 10-19.

AGSX5 = Male household members aged 20-44.

AGSX6 = Female household members aged 20-44.

AGSX7 = Male household members aged 45-64.

AGSX8 = Female household members aged 45-64.

AGSX9 = Male household members aged ≥65.

AGSX10 = Female household members aged ≥65, selected as base dummy variable.

ED1 = Education level of head of household P. 7 or less.

ED2 = Education level of head household more >P. 7 but <S. 6.

[d] Statistical significance at 5% level.

Table 4.18: Urban Demographic Coefficients: Maize.

	Central		East		North		West	
	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr
BUDGET SHARE								
AGSX1	-0.09	0.06	-0.03	0.08	0.12	0.08	-0.06	0.06
AGSX2	-0.10	0.07	0.02	0.08	-0.08	0.06	-0.06	0.06
AGSX3	0.03	0.06	-0.01	0.06	-0.17	0.09	[d]0.12	0.05
AGSX4	-0.09	0.06	-0.03	0.06	0.12	0.07	-0.04	0.05
AGSX5	0.05	0.04	-0.01	0.04	0.02	0.05	-0.04	0.04
AGSX6	[d]-0.10	0.04	[d]-0.13	0.05	-0.01	0.04	[d]-0.11	0.04
AGSX7	-0.06	0.06	-0.01	0.06	-0.02	0.08	0.06	0.06
AGSX8	-0.09	0.13	-0.09	0.07	0.01	0.07	-0.12	0.07
AGSX9	-0.02	0.13	0.14	0.11	-0.03	0.11	0.05	0.09
ED1	0.01	0.02	[d]0.03	0.01	0.00	0.01	0.00	0.01
ED2	0.00	0.01	0.00	0.01	0.01	0.01	0.00	0.01
UNIT VALUE								
AGSX1	-0.03	0.06	0.03	0.11	0.01	0.19	0.19	0.13
AGSX2	0.02	0.07	-0.02	0.10	0.08	0.12	-0.01	0.13
AGSX3	-0.03	0.05	0.06	0.08	-0.16	0.24	0.07	0.09
AGSX4	0.05	0.06	-0.05	0.10	-0.31	0.20	0.19	0.10
AGSX5	-0.03	0.04	[d]0.11	0.05	-0.23	0.14	0.05	0.08
AGSX6	0.01	0.04	0.06	0.06	-0.27	0.14	0.05	0.09
AGSX7	0.00	0.06	0.05	0.07	0.03	0.20	0.13	0.12
AGSX8	-0.01	0.13	-0.09	0.09	-0.37	0.19	0.23	0.16
AGSX9	-0.10	0.14	0.14	0.16	0.22	0.45	0.12	0.25
ED1	-0.04	0.02	0.00	0.02	0.03	0.04	-0.02	0.03
ED2	0.00	0.01	0.00	0.01	-0.03	0.03	-0.01	0.02

AGSX1 = Male and female household members aged 0-4.

AGSX2 = Male and female households members aged 5-9.

AGSX3 = Male household members aged 10-19.

AGSX3 = Male household members aged 10-19.

AGSX5 = Male household members aged 20-44.

AGSX6 = Female household members aged 20-44.

AGSX7 = Male household members aged 45-64.

AGSX8 = Female household members aged 45-64.

AGSX9 = Male household members aged ≥65.

AGSX10 = Female household members aged ≥65, selected as base dummy variable.

ED1 = Education level of head of household P. 7 or less.

ED2 = Education level of head household more >P. 7 but <S. 6.

[d]Statistical significance at 5% level.

Table 4.19: Urban Demographic Coefficients: Millet.

	Central		East		North		West	
	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr
BUDGET SHARE								
AGSX1	0.01	0.02	-0.06	0.04	-0.01	0.04	0.04	0.03
AGSX2	0.01	0.02	-0.07	0.04	-0.01	0.03	0.00	0.03
AGSX3	0.01	0.02	0.04	0.03	-0.01	0.05	0.00	0.02
AGSX4	0.00	0.02	-0.05	0.04	-0.02	0.04	0.01	0.02
AGSX5	[d]0.02	0.01	0.02	0.02	-0.02	0.03	0.01	0.01
AGSX6	0.02	0.01	[d]0.09	0.03	-0.04	0.02	-0.01	0.02
AGSX7	0.01	0.02	0.04	0.03	-0.06	0.05	0.02	0.02
AGSX8	0.01	0.04	0.02	0.04	-0.02	0.04	-0.02	0.03
AGSX9	0.00	0.04	0.01	0.06	-0.01	0.06	0.00	0.04
ED1	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.00
ED2	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00
UNIT VALUE								
AGSX1	0.00	0.15	-0.06	0.19	-0.03	0.12	0.20	0.21
AGSX2	0.00	0.23	-0.18	0.20	-0.15	0.10	0.21	0.19
AGSX3	0.33	0.21	0.17	0.12	0.09	0.14	-0.03	0.11
AGSX4	0.23	0.19	-0.21	0.15	-0.14	0.10	-0.14	0.19
AGSX5	-0.05	0.10	0.13	0.11	0.04	0.11	-0.11	0.12
AGSX6	-0.01	0.12	0.22	0.11	0.03	0.09	-0.23	0.14
AGSX7	-0.07	0.14	0.27	0.16	0.12	0.17	-0.07	0.31
AGSX8	0.12	0.71	0.24	0.38	0.01	0.09	-0.12	0.19
AGSX9	0.54	1.71	0.56	0.34	-0.15	0.28	-0.64	0.91
ED1	-0.06	0.08	0.00	0.05	-0.02	0.01	-0.04	0.05
ED2	0.00	0.03	0.00	0.02	0.00	0.02	0.02	0.02

AGSX1 = Male and female household members aged 0-4.

AGSX2 = Male and female households members aged 5-9.

AGSX3 = Male household members aged 10-19.

AGSX3 = Male household members aged 10-19.

AGSX5 = Male household members aged 20-44.

AGSX6 = Female household members aged 20-44.

AGSX7 = Male household members aged 45-64.

AGSX8 = Female household members aged 45-64.

AGSX9 = Male household members aged $\geq$65.

AGSX10 = Female household members aged $\geq$65, selected as base dummy variable.

ED1 = Education level of head of household P. 7 or less.

ED2 = Education level of head household more >P. 7 but <S. 6.

[d] Statistical significance at 5% level.

Table 4.20: Urban Demographic Coefficients: Beef.

	Central		East		North		West	
	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr
BUDGET SHARE								
AGSX1	-0.06	0.06	-0.21	0.09	-0.03	0.13	-0.05	0.07
AGSX2	-0.07	0.07	-0.07	0.10	-0.09	0.10	0.06	0.07
AGSX3	0.04	0.06	0.09	0.07	-0.03	0.15	0.07	0.05
AGSX4	0.01	0.06	0.14	0.08	0.02	0.11	0.07	0.05
AGSX5	0.02	0.04	0.09	0.05	0.12	0.08	0.06	0.04
AGSX6	-0.04	0.04	0.09	0.06	0.13	0.07	0.10	0.04
AGSX7	0.02	0.06	0.07	0.07	0.13	0.14	0.06	0.07
AGSX8	0.03	0.13	0.00	0.09	-0.09	0.12	0.03	0.08
AGSX9	0.07	0.13	0.10	0.13	0.03	0.19	-0.07	0.10
ED1	-0.02	0.02	-0.02	0.02	-0.02	0.02	-0.02	0.01
ED2	-0.01	0.01	0.00	0.01	-0.02	0.02	-0.01	0.01
UNIT VALUE								
AGSX1	0.03	0.04	^{d}-0.03	0.04	0.00	0.03	-0.02	0.03
AGSX2	0.08	0.05	0.00	0.04	-0.05	0.02	0.03	0.03
AGSX3	-0.03	0.04	-0.02	0.03	0.02	0.04	-0.04	0.02
AGSX4	0.03	0.04	-0.02	0.03	0.08	0.03	^{d}0.07	0.02
AGSX5	-0.01	0.03	0.00	0.02	0.01	0.02	0.01	0.02
AGSX6	0.00	0.03	0.01	0.02	0.01	0.02	^{d}-0.02	0.02
AGSX7	-0.04	0.05	0.03	0.03	-0.01	0.04	-0.04	0.03
AGSX8	0.13	0.10	-0.04	0.04	-0.03	0.03	0.09	0.04
AGSX9	0.04	0.13	-0.01	0.06	-0.01	0.05	-0.06	0.05
ED1	-0.02	0.01	0.00	0.01	0.00	0.01	-0.01	0.01
ED2	^{d}-0.02	0.01	-0.01	0.00	-0.01	0.00	0.00	0.00

AGSX1 = Male and female household members aged 0-4.

AGSX2 = Male and female households members aged 5-9.

AGSX3 = Male household members aged 10-19.

AGSX3 = Male household members aged 10-19.

AGSX5 = Male household members aged 20-44.

AGSX6 = Female household members aged 20-44.

AGSX7 = Male household members aged 45-64.

AGSX8 = Female household members aged 45-64.

AGSX9 = Male household members aged $\geq$65.

AGSX10 = Female household members aged $\geq$65, selected as base dummy variable.

ED1 = Education level of head of household P. 7 or less.

ED2 = Education level of head household more >P. 7 but <S. 6.

^{d}Statistical significance at 5% level.

Table 4.21: Urban Demographic Coefficients: Beans.

	Central		East		North		West	
	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr	Estimate	Stderr
BUDGET SHARE								
AGSX1	[d]-0.08	0.03	-0.03	0.06	[d]-0.23	0.11	-0.03	0.04
AGSX2	[d]-0.07	0.04	-0.11	0.06	0.01	0.08	[d]0.09	0.04
AGSX3	0.01	0.03	0.01	0.05	-0.02	0.12	0.00	0.03
AGSX4	0.03	0.03	0.00	0.05	0.13	0.09	-0.02	0.03
AGSX5	[d]0.06	0.02	0.02	0.03	0.06	0.06	-0.01	0.02
AGSX6	0.02	0.02	0.02	0.04	0.00	0.06	0.04	0.03
AGSX7	[d]0.09	0.03	0.05	0.04	0.07	0.11	-0.04	0.04
AGSX8	0.06	0.06	0.02	0.06	-0.03	0.09	0.04	0.05
AGSX9	-0.01	0.06	-0.08	0.09	0.13	0.15	-0.03	0.06
ED1	0.01	0.01	-0.01	0.01	0.01	0.02	0.00	0.01
ED2	0.00	0.00	0.01	0.01	-0.01	0.01	0.00	0.00
UNIT VALUE								
AGSX1	0.06	0.08	-0.06	0.10	-0.03	0.11	-0.20	0.17
AGSX2	-0.09	0.11	-0.15	0.10	-0.06	0.08	0.17	0.15
AGSX3	[d]-0.19	0.08	-0.05	0.07	0.14	0.11	0.13	0.11
AGSX4	-0.10	0.08	0.01	0.09	[d]0.20	0.09	0.04	0.14
AGSX5	-0.02	0.05	-0.04	0.06	[d]0.14	0.07	0.03	0.09
AGSX6	-0.10	0.06	-0.11	0.06	0.02	0.07	[d]0.22	0.10
AGSX7	-0.08	0.09	0.03	0.08	-0.04	0.11	-0.03	0.18
AGSX8	-0.17	0.17	-0.16	0.09	0.10	0.11	0.35	0.21
AGSX9	0.27	0.52	-0.30	0.16	0.09	0.28	0.09	0.20
ED1	0.00	0.03	0.01	0.02	-0.02	0.02	-0.05	0.03
ED2	-0.02	0.01	0.02	0.01	0.00	0.02	0.00	0.02

AGSX1 = Male and female household members aged 0-4.

AGSX2 = Male and female households members aged 5-9.

AGSX3 = Male household members aged 10-19.

AGSX3 = Male household members aged 10-19.

AGSX5 = Male household members aged 20-44.

AGSX6 = Female household members aged 20-44.

AGSX7 = Male household members aged 45-64.

AGSX8 = Female household members aged 45-64.

AGSX9 = Male household members aged $\geq$65.

AGSX10 = Female household members aged $\geq$65, selected as base dummy variable.

ED1 = Education level of head of household P. 7 or less.

ED2 = Education level of head household more >P. 7 but <S. 6.

[d] Statistical significance at 5% level.

4.4.2 Coefficients of household size and expenditure, and expenditure elasticities

Household size and expenditure coefficients from the regression of both the budget share and unit value equations are contained in Tables 4.22 to 4.25. The calculated expenditure elasticity is also included.

Budget share responses to total expenditure ($w\colon \ln x$)

As in Deaton [9], the negative values of the effect of the logarithm of total expenditure on budget shares corresponds to expenditure elasticities less than unity. A negative value indicates a reduction in the budget share of the food in question with a rise in per capita expenditure. An increase in per capita expenditure (income) translates into a price drop enabling the household to spend less on the item but still maintain or even increase the quantity consumed. Food items with expenditure elasticities of more than unity are considered luxury items. Almost all the parameter estimates for the effect of the logarithm of total expenditure on budget shares came up significant and negative in all regions.

Budget share responses to household size ($w\colon \ln hhs$)

Negative household size coefficients imply that an increase in the household size will lead to a decrease in the budget share allocated to the food. This by far was the more common result. Increases in household size are likely to be in terms of new births whose demands will be quite different from the rest of the household and, perhaps, of more immediate importance such that with fixed incomes we may observe an expenditure reallocation away from the food staples considered here. Deaton et al. [11] found that additional adults (14 and up) had positive effects on expenditure while additional children (0-13) had negative effects. The central and eastern region's budget shares seem to be most affected by an increase in household size. The magnitudes in all cases were quite small. Household size appears to have no strong influence on budget allocation decisions.

Expenditure elasticities ($e_i = 1 - \beta_i^1 + \beta_I^0 w_i^{-1}$)

Expenditure elasticities in tables were evaluated at the data sample means of households in the respective regions. All expenditure elasticities were of the correct sign and ranged from a low of 0.32 to a high of 1.02. That all expenditure elasticities were positive shows that even households in higher income regions will consume more of these staples with an increase in per capita expenditure. On average the rural elasticities were larger than those of corresponding urban regions. The rural-north, being the poorest region, consistently had the highest food expenditure elasticities with the exception of cassava, millet and beans which happen to be its basic foods. Rural-central, with the highest rural income households, had as expected, the lowest expenditure elasticities on average among the rural sectors. The rural east was determined earlier as having poorer households compared to the west. The results between these two were consistent with this finding. Rural-east expenditure elasticities were consistently larger than those of rural-west except with respect to sweet potatoes. These two regions are the highest per capita consumers of sweet potatoes with rural-east slightly edging out rural-west [25].

The urban regional results were mixed and did not seem to follow any set pattern. Urban-west, controversially determined as the poorest urban region earlier, had the four lowest expenditure elasticities out of a possible seven. The urban-central region, home to the highest income households, had only one to show for it. The within-region results did, however, appear consistent. Urban-Central results were consistent with expectations. Matoke and Beef had the highest expenditure elasticities and cassava, a relatively inferior food, had the least. The high matoke elasticity in Urban-east was consistent with price statistics in Table 4.5 that show this region as having exceedingly high Matoke prices.

Quality Elasticities, $(\ln v : \ln x)$

With the exception of beef and millet in rural-central, all quality elasticity estimates were positive and small in magnitude showing positive but little response to food quality attributes amongst Ugandan rural and urban households. The negative beef and millet parameters imply a decline in quality preference for these commodities with increases in total expenditure. Deaton [9] rural quality elasticities came out smaller than the urban ones. He attributed this finding to there being less variety and , hence, very limited choice in the rural areas. Results in this study followed no clear pattern. Beef being a luxury food was expected to carry a high quality elasticity. In neither the rural nor urban results was this the case. In fact in urban-central it showed up as negative.

Sweet potato purchases turned up as the most sensitive to quality in the rural setting followed by Matoke and Beans. In the urban setting, Matoke purchases had the highest quality elasticities followed by sweet potatoes and a tie between beans and corn.

Quality responses to changes in household size, ($\ln v : \ln hhsz$)

According to Deaton [9], as with budget shares, increases in household size typically act in much the same way as decreases in expenditure. We would, hence, expect negative coefficients showing a decline in quality of purchased commodities with an increase in household size. However, the study ended up with mixed results. Most of the coefficients turned up positive, and several are significant.

4.5 First-Stage Variances, Covariances and Cluster Sizes

4.5.1 Residual Variances and Covariances

Tables 4.26 to 4.29 contain estimates of variances and covariances of each of the seven food staples consumed in the 8 regional rural and urban sectors. Variance estimate $\tilde{\sigma}^{00}$ in column one corresponds to the diagonal of $\tilde{\Sigma}$ and measures the variance of measurement error in calculated budget shares. Estimate $\tilde{\sigma}^{11}$ corresponds to the diagonal of $\tilde{\Omega}$ and is a measure of the variance of measurement error in the calculated unit values. And $\tilde{\sigma}^{10}$ corresponds to matrix $\tilde{\Gamma}$ (see page 39). The covariance matrix estimate $\tilde{\sigma}^{10}$ is the main focus here because it is indicative of the importance of measurement error and its magnitude affects the size of the corrections made for the presence of measurement error (see pages 36 and 37, and equation 3.35).

If we suppose that the errors of measurement in reported expenditures are orthogonal to the errors in reported quantities, then the error in the unit value will have a positive covariance ($\tilde{\sigma}^{10}$) with the error in the share [7, 8]. Looking at the values of $\tilde{\sigma}^{10}$ in Tables 4.26 to 4.29 all are positive with the exception of maize in rural east, matoke in rural north and millet in urban west. The negative values suggest measurement error in either reported quantities or expenditures. The zero value of $\tilde{\sigma}^{10}$ for millet in 4.26 indicates clear independence of measurement errors of its expenditures and unit values

Table 4.22: First Stage Regression Estimates (Central Region).

	$w : \ln X$	$w : \ln hhsz$	e_i	$\ln v : \ln x$	$\ln v : \ln hhsz$
RURAL					
Matoke	^{d}-0.071	^{d}-0.149	^{d}0.61	^{d}0.239	^{d}0.313
	(0.01)	(0.03)	(0.09)	(0.04)	(0.09)
Sweet potatoes	^{d}-0.132	^{d}-0.097	^{d}0.56	^{d}0.119	0.134
	(0.01)	(0.04)	(0.10)	(0.04)	(0.10)
Cassava	^{d}-0.036	^{d}0.159	^{d}0.78	^{d}0.109	^{d}0.159
	(0.01)	(0.03)	(0.12)	(0.02)	(0.07)
Maize	^{d}-0.134	^{d}-0.082	^{d}0.46	0.039	-0.023
	(0.01)	(0.01)	(0.17)	(0.03)	(0.04)
Millet	^{d}-0.008	-0.001	^{d}0.92	0.013	0.089
	(0.00)	(0.04)	(0.01)	(0.01)	(0.13)
Beef	^{d}-0.107	^{d}-0.088	^{d}0.52	^{d}0.063	0.033
	(0.01)	(0.01)	(0.18)	(0.03)	(0.03)
Beans	^{d}-0.063	-0.018	0.6	^{d}0.037	0.058
	(0.01)	(0.02)	(0.35)	(0.02)	(0.07)
	$w : \ln x$	$w : \ln hhsz$	e_i	$\ln v : \ln x$	$\ln v : \ln hhsz$
URBAN					
Matoke	-0.007	^{d}-0.058	^{d}0.84	^{d}0.148	0.009
	(0.02)	(0.02)	(0.11)	(0.02)	(0.02)
Sweet potatoes	^{d}-0.077	^{d}-0.112	0.51	^{d}0.188	^{d}0.116
	(0.02)	(0.02)	(0.33)	(0.02)	(0.02)
Cassava	^{d}-0.08	-0.063	0.43	^{d}0.199	^{d}0.255
	(0.01)	(0.03)	(0.25)	(0.04)	(0.07)
Maize	^{d}-0.109	^{d}-0.146	0.42	^{d}0.046	0.012
	(0.02)	(0.02)	(0.49)	(0.02)	(0.02)
Millet	^{d}-0.028	0.007	0.76	^{d}-0.019	0.012
	(0.01)	(0.01)	(0.88)	(0.01)	(0.01)
Beef	^{d}-0.081	0.027	^{d}0.78	^{d}-0.081	^{d}-0.072
	(0.02)	(0.02)	(0.30)	(0.02)	(0.02)
Beans	^{d}-0.048	0.005	0.54	^{d}0.078	^{d}-0.051
	(0.01)	(0.01)	(0.64)	(0.01)	(0.01)

^{d}Statistical significance at 5% level.

Notes: e_i is the expenditure elasticity evaluated at the data sample means of households, w is the budget share, $\ln v$ is log of the unit value, $\ln x$ is log of the total per capita expenditure, and $hhsz$ household size such that $w : \ln x$ is the regression coefficient of the regression of w on $\ln x$, and similarly for the other rows. Absolute t-values are given in parentheses.

Table 4.23: First Stage Regression Estimates (Eastern Region).

	$w : \ln x$	$w : \ln hhsz$	e_i	$\ln v : \ln x$	$\ln v : \ln hhsz$
RURAL					
Matoke	^{d}-0.052	^{d}-0.188	^{d}0.71	^{d}0.171	^{d}-0.188
	(0.02)	(0.05)	(0.18)	(0.07)	(0.07)
Sweet potatoes	-0.009	-0.05	^{d}0.71	^{d}0.262	0.119
	(0.01)	(0.07)	(0.17)	(0.04)	(0.22)
Cassava	-0.022	^{d}-0.127	^{d}0.9	0.046	-0.187
	(0.02)	(0.05)	(0.20)	(0.06)	(0.15)
Maize	^{d}-0.072	^{d}-0.066	^{d}0.77	0.027	-0.152
	(0.02)	(0.03)	(0.23)	(0.06)	(0.10)
Millet	^{d}-0.021	-0.044	^{d}0.92	0.022	-0.077
	(0.01)	(0.07)	(0.12)	(0.03)	(0.26)
Beef	^{d}-0.168	^{d}-0.045	^{d}0.94	0.026	^{d}-0.089
	(0.02)	(0.01)	(0.16)	(0.08)	(0.04)
Beans	^{d}-0.268	^{d}-0.237	^{d}0.85	0.068	-0.118
	(0.02)	(0.03)	(0.26)	(0.08)	(0.12)
	$w : \ln x$	$w : \ln hhsz$	e_i	$\ln v : \ln x$	$\ln v : \ln hhsz$
URBAN					
Matoke	0.013	0.023	^{d}1.02	^{d}0.181	0.178
	(0.02)	(0.04)	(0.18)	(0.05)	(0.10)
Sweet potatoes	^{d}-0.106	^{d}-0.124	^{d}0.9	0.058	^{d}0.244
	(0.02)	(0.05)	(0.30)	(0.05)	(0.11)
Cassava	^{d}-0.158	^{d}-0.148	^{d}0.88	^{d}0.085	0.032
	(0.02)	(0.02)	(0.13)	(0.02)	(0.02)
Maize	^{d}-0.049	^{d}-0.093	^{d}0.75	^{d}0.086	^{d}0.097
	(0.01)	(0.01)	(0.25)	(0.01)	(0.01)
Millet	^{d}-0.029	0.01	^{d}0.79	^{d}0.072	^{d}0.161
	(0.01)	(0.01)	(0.27)	(0.01)	(0.01)
Beef	^{d}-0.059	-0.014	^{d}0.81	0.021	0.016
	(0.02)	(0.02)	(0.22)	(0.02)	(0.02)
Beans	^{d}-0.086	-0.02	^{d}0.54	0.00	^{d}-0.029
	(0.01)	(0.01)	(0.25)	(0.01)	(0.01)

^{d}Statistical significance at 5% level.

Notes: e_i is the expenditure elasticity evaluated at the data sample means of households, w is the budget share, $\ln v$ is log of the unit value, $\ln x$ is log of the total per capita expenditure, and $hhsz$ household size such that $w : \ln x$ is the regression coefficient of the regression of w on $\ln x$, and similarly for the other rows. Absolute t-values are given in parentheses.

Table 4.24: First Stage Regression Estimates (Northern Region).

	$w : \ln x$	$w : \ln hhsz$	e_i	$\ln v : \ln x$	$\ln v : \ln hhsz$
RURAL					
Matoke	^{d}-0.029	-0.043	^{d}0.87	^{d}0.059	^{d}0.262
	(0.01)	(0.05)	(0.08)	(0.02)	(0.19)
Sweet potatoes	^{d}-0.147	^{d}-0.193	^{d}0.80	^{d}0.176	^{d}0.238
	(0.01)	(0.03)	(0.08)	(0.05)	(0.12)
Cassava	^{d}-0.038	0.002	^{d}0.80	^{d}0.112	^{d}0.128
	(0.01)	(0.01)	(0.06)	(0.01)	(0.01)
Maize	^{d}-0.024	0.001	^{d}0.85	^{d}0.089	^{d}0.218
	(0.01)	(0.02)	(0.08)	(0.02)	(0.08)
Millet	^{d}-0.035	0.016	^{d}0.84	^{d}0.046	-0.031
	(0.01)	(0.03)	(0.12)	(0.02)	(0.10)
Beef	^{d}-0.134	^{d}-0.119	^{d}0.94	^{d}0.032	0.050
	(0.01)	(0.01)	(0.08)	(0.04)	(0.03)
Beans	^{d}-0.133	0.016	^{d}0.57	0.075	^{d}0.154
	(0.01)	(0.02)	(0.11)	(0.04)	(0.07)
	$w : \ln x$	$w : \ln hhsz$	e_i	$\ln v : \ln x$	$\ln v : \ln hhsz$
URBAN					
Matoke	-0.015	^{d}-0.057	^{d}0.60	^{d}0.335	^{d}0.321
	(0.01)	(0.01)	(0.18)	(0.01)	(0.01)
Sweet potatoes	^{d}-0.084	^{d}-0.093	0.54	^{d}0.083	^{d}0.248
	(0.02)	(0.02)	(0.41)	(0.02)	(0.02)
Cassava	^{d}-0.077	^{d}-0.172	^{d}0.70	^{d}0.097	^{d}0.103
	(0.03)	(0.03)	(0.23)	(0.03)	(0.03)
Maize	^{d}-0.105	-0.033	^{d}0.62	0.027	-0.269
	(0.02)	(0.02)	(0.25)	(0.02)	(0.02)
Millet	-0.010	-0.041	^{d}0.91	^{d}0.041	^{d}0.002
	(0.01)	(0.03)	(0.27)	(0.02)	(0.08)
Beef	^{d}-0.183	^{d}-0.140	^{d}0.92	0.030	0.018
	(0.03)	(0.03)	(0.22)	(0.03)	(0.03)
Beans	^{d}-0.159	^{d}-0.048	^{d}0.87	^{d}0.072	^{d}0.118
	(0.02)	(0.02)	(0.25)	(0.02)	(0.02)

^{d}Statistical significance at 5% level.

Notes: e_i is the expenditure elasticity evaluated at the data sample means of households, w is the budget share, $\ln v$ is log of the unit value, $\ln x$ is log of the total per capita expenditure, and $hhsz$ household size such that $w : \ln x$ is the regression coefficient of the regression of w on $\ln x$, and similarly for the other rows. Absolute t-values are given in parentheses.

Table 4.25: First Stage Regression Estimates (Western Region).

RURAL	$w : \ln x$	$w : \ln hhsz$	e_i	$\ln v : \ln x$	$\ln v : \ln hhsz$
Matoke	^{d}-0.043	-0.035	^{d}0.70	^{d}0.235	0.444
	(0.01)	(0.04)	(0.08)	(0.05)	(0.44)
Sweet potatoes	^{d}-0.024	-0.001	^{d}0.82	^{d}0.090	0.356
	(0.00)	(0.05)	(0.08)	(0.02)	(0.36)
Cassava	^{d}-0.030	-0.014	^{d}0.84	^{d}0.078	0.105
	(0.01)	(0.03)	(0.06)	(0.02)	(0.11)
Maize	^{d}-0.099	^{d}-0.072	^{d}0.64	0.030	0.058
	(0.01)	(0.02)	(0.08)	(0.03)	(0.06)
Millet	^{d}-0.012	-0.011	^{d}0.81	^{d}0.139	0.338
	(0.00)	(0.05)	(0.12)	(0.01)	(0.34)
Beef	^{d}-0.204	^{d}-0.160	^{d}0.32	^{d}0.024	0.042
	(0.01)	(0.01)	(0.08)	(0.04)	(0.04)
Beans	^{d}-0.048	-0.017	^{d}0.76	^{d}0.082	0.117
	(0.01)	(0.03)	(0.11)	(0.02)	(0.12)

URBAN	$w : \ln X$	$w : \ln hhsz$	e_i	$\ln v : \ln x$	$\ln v : \ln hhsz$
Matoke	-0.006	^{d}0.067	^{d}0.72	^{d}0.272	^{d}0.219
	(0.03)	(0.03)	(0.18)	(0.07)	(0.08)
Sweet potatoes	^{d}-0.076	-0.031	^{d}0.49	^{d}0.172	^{d}0.332
	(0.01)	(0.05)	(0.23)	(0.03)	(0.13)
Cassava	^{d}-0.076	0.037	0.50	^{d}0.131	0.040
	(0.02)	(0.05)	(0.51)	(0.04)	(0.12)
Maize	^{d}-0.117	^{d}-0.168	0.33	^{d}0.107	0.112
	(0.02)	(0.04)	(0.51)	(0.04)	(0.09)
Millet	^{d}-0.018	0.019	0.82	0.027	-0.176
	(0.01)	(0.06)	(0.72)	(0.02)	(0.14)
Beef	^{d}-0.116	^{d}0.013	^{d}0.52	^{d}0.031	0.019
	(0.02)	(0.01)	(0.35)	(0.05)	(0.02)
Beans	^{d}-0.067	^{d}-0.024	^{d}0.51	^{d}0.122	0.205
	(0.01)	(0.04)	(0.33)	(0.03)	(0.11)

^{d}Statistical significance at 5% level.

Notes: e_i is the expenditure elasticity evaluated at the data sample means of households, w is the budget share, $\ln v$ is log of the unit value, $\ln x$ is log of the total per capita expenditure, and $hhsz$ household size such that $w : \ln x$ is the regression coefficient of the regression of w on $\ln x$, and similarly for the other rows. Absolute t-values are given in parentheses.

The residual variances and covariances contained in Tables 4.26 to 4.29 are generally of larger magnitude in the rural than in corresponding urban sectors. This may be attributed to the larger proportion of imputed food expenditures in the rural areas.

Table 4.26: First-Stage Variances, Covariances and Cluster Sizes: Central Region.

	$\tilde{\sigma}^{00}$	$\tilde{\sigma}^{11}$	$\tilde{\sigma}^{10}$	n	n_+
RURAL					
Matoke	0.04477	0.05013	0.00075	40.3	26.3
Sweet Potatoes	0.04419	0.03251	0.00845	26.8	11.3
Cassava	0.01348	0.02680	0.00721	13.7	15.5
Maize	0.02763	0.01750	0.00400	26.1	26.6
Millet	0.00127	0.01534	0.00000	3.9	3.9
Beef	0.01728	0.00903	0.00382	31.6	31.6
URBAN					
Beans	0.00716	0.02288	0.00184	17.4	17.4
Matoke	0.03922	0.02872	0.00565	18.58	6.60
Sweet Potatoes	0.02322	0.02301	0.00737	17.33	10.83
Cassava	0.01512	0.02615	0.00501	6.29	7.83
Maize	0.01900	0.00942	0.00378	12.99	12.73
Millet	0.00208	0.01681	0.00193	3.32	3.32
Beef	0.02020	0.00642	0.00309	20.46	20.13
Beans	0.00460	0.01363	0.00246	5.95	5.95

$\tilde{\sigma}^{00}$,$\tilde{\sigma}^{11}$, and $\tilde{\sigma}^{10}$ are the residual variances of the budget share equation, the unit-value equation, and the covariance between them respectively. n, and n_+ are the elements of the matrices N and N^+ and are defined as 'averages' of numbers of households per cluster, in total and reporting purchases of the particular food staple.

4.5.2 Cluster Sizes

The values n and n_+ in Tables 4.26 to 4.29 are the diagonal elements of N and N_+ in equation 3.35.They are defined as 'averages' of numbers of households per cluster, in total, and of those reporting purchases of the food staple respectively. In conjunction with the residual variances and covariances they are used to correct for measurement error in the cross-cluster variance of mean unit value and its covariance with the budget share in the second stage of estimation; (see equation 3.35).

With only few exceptions, the values n and n_+ in Tables 4.26 to 4.29 are of the same magnitude. This indicates that most households consuming the particular staples are largely also the same ones that purchase them. The magnitudes of these values vary considerably

Table 4.27: First-Stage Variances, Covariances and Cluster Sizes: Eastern Region.

	$\tilde{\sigma}^{00}$	$\tilde{\sigma}^{11}$	$\tilde{\sigma}^{10}$	n	n_+
RURAL					
Matoke	0.03343	0.03963	0.00119	11.73	8.36
Sweet Potatoes	0.00924	0.03888	0.01285	9.69	9.69
Cassava	0.02035	0.02745	0.01116	9.80	9.85
Maize	0.02163	0.01661	-0.00123	9.43	9.43
Millet	0.00553	0.01578	0.01010	3.24	3.24
Beef	0.03662	0.00466	0.00104	16.52	15.37
Beans	0.03349	0.01764	0.00101	16.71	11.72
URBAN					
Matoke	0.02694	0.03607	0.01102	13.31	11.37
Sweet Potatoes	0.02132	0.03853	0.00476	21.81	12.55
Cassava	0.04572	0.02042	0.00953	10.85	11.14
Maize	0.01719	0.00901	0.00074	10.20	10.20
Millet	0.00554	0.01313	0.00006	2.78	2.78
Beef	0.02607	0.00263	0.00093	27.43	27.43
Beans	0.01068	0.01118	0.00363	18.38	18.38

$\tilde{\sigma}^{00}$,$\tilde{\sigma}^{11}$, and $\tilde{\sigma}^{10}$ are the residual variances of the budget share equation, the unit-value equation, and the covariance between them respectively. n, and n_+ are the elements of the matrices N and N^+ and are defined as 'averages' of numbers of households per cluster, in total and reporting purchases of the particular food staple.

Table 4.28: First-Stage Variances, Covariances and Cluster Sizes: Northern Region.

	$\tilde{\sigma}^{00}$	$\tilde{\sigma}^{11}$	$\tilde{\sigma}^{10}$	n	n_+
RURAL					
Matoke	0.00818	0.03046	-0.00102	2.68	2.26
Sweet Potatoes	0.05224	0.04097	0.00797	21.37	5.54
Cassava	0.01726	0.03771	0.00977	5.18	10.02
Maize	0.01125	0.02079	0.00208	5.27	5.27
Millet	0.00755	0.02131	0.00407	5.29	5.29
Beef	0.02519	0.00534	0.00239	18.65	18.65
Beans	0.02955	0.02926	0.00877	24.03	24.03
URBAN					
Matoke	0.00523	0.02260	0.00184	6.02	4.73
Sweet Potatoes	0.01137	0.01786	0.00211	7.08	7.08
Cassava	0.02567	0.02302	0.00738	22.01	19.69
Maize	0.01158	0.01662	0.00559	4.86	3.68
Millet	0.00004	0.00393	0.00040	2.75	2.75
Beef	0.03211	0.00161	0.00189	29.48	29.48
Beans	0.02083	0.01383	0.00263	6.47	6.47

$\tilde{\sigma}^{00}$,$\tilde{\sigma}^{11}$, and $\tilde{\sigma}^{10}$ are the residual variances of the budget share equation, the unit-value equation, and the covariance between them respectively. n, and n_+ are the elements of the matrices N and N^+ and are defined as 'averages' of numbers of households per cluster, in total and reporting purchases of the particular food staple.

Table 4.29: First-Stage Variances, Covariances and Cluster Sizes: Western Region.

	$\tilde{\sigma}^{00}$	$\tilde{\sigma}^{11}$	$\tilde{\sigma}^{10}$	n	n_+
RURAL					
Matoke	0.04256	0.04960	0.00865	13.03	11.47
Sweet Potatoes	0.00558	0.05007	0.01562	8.60	8.06
Cassava	0.00903	0.02956	0.00129	3.98	3.42
Maize	0.01621	0.02542	0.00202	8.57	8.57
Millet	0.00006	0.02985	0.00367	4.52	4.52
Beef	0.02722	0.00500	0.00198	25.40	25.40
Beans	0.01093	0.02525	0.00531	10.82	10.82
URBAN					
Matoke	0.04202	0.02896	0.00835	32.55	24.04
Sweet Potatoes	0.00846	0.04159	0.00609	13.76	13.76
Cassava	0.01304	0.03207	0.00376	6.16	5.92
Maize	0.01303	0.02387	0.00487	14.98	14.40
Millet	0.00204	0.01381	-0.00056	5.32	5.32
Beef	0.01024	0.00236	0.00068	26.31	25.68
Beans	0.00585	0.02270	0.00441	10.99	10.99

$\tilde{\sigma}^{00}$,$\tilde{\sigma}^{11}$, and $\tilde{\sigma}^{10}$ are the residual variances of the budget share equation, the unit-value equation, and the covariance between them respectively. n, and n_+ are the elements of the matrices N and N^+ and are defined as 'averages' of numbers of households per cluster, in total and reporting purchases of the particular food staple.

within each rural and urban sector reflecting the importance placed on the particular staple. Note the very low values recorded for matoke in rural north were it is not eaten much. Beef values are relatively high in all sectors suggesting beef is eaten widely albeit in small quantities because of cost.

Urban sector cluster sizes are uniformly larger than those of the rural sector in all regions. This is because of the higher concentration of households resulting in larger cluster sizes.

4.6 Cross-Cluster Variances and Covariances and Corrections

In the estimation of the second stage, the effects of the budget shares and unit values are netted out and cluster averages of the corrected budget shares and unit values calculated for all seven food staples in each rural and urban sector (see equations 3.28 and 3.29). The ensuing mean budget shares and unit values are then used to calculate matrix estimates $\tilde{R}$, and $\tilde{S}$, according to equations in 3.34. Matrix $\tilde{R}$ for each sector is a 7x7 covariance matrix of the corrected budget shares and unit values. Note that although most clusters have at least one household recording a purchase of each staple there are instances were this may not obtain. In such cases, each covariance was calculated over that subset of clusters that contained means for that pair of corrected budget shares and unit values. For example, the matoke-beef covariance was not calculated over the same clusters as the cassava-maize covariance. Matrix $\tilde{S}$ is, on the other hand, a 7x7 variance matrix estimate of the corrected budget shares only. The ratio $\tilde{S}^{-1}\tilde{R}$ is a 7x7 matrix OLS estimator of the regression of corrected budget shares on cluster price represented as the ratio of the covariance matrix $\tilde{R}$ to variance matrix $\tilde{S}$. This estimator is, however, plagued by measurement error which can be gotten rid of by subtracting matrices $\tilde{\Omega}\tilde{N}^{-1}$ and $\tilde{\Gamma}\tilde{N}_{+}$ from $\tilde{S}$ and $\tilde{R}$ respectively resulting in a 7x7 diagonal matrix estimate $\tilde{B}$ (see equation 3.35). In the absence of measurement error $\tilde{S}^{-1}\tilde{R}$ would suffice as the OLS estimator of the regression of corrected budget shares on the corrected unit values.

Tables 4.30 to 4.33 contain the $\tilde{R}$ and $\tilde{S}$ estimates, the uncorrected OLS estimator as $\tilde{S}^{-1}\tilde{R}$, and then as $\tilde{B}$ after the correction. Values e_1 and e_2 are own price elasticities calculated using $\tilde{S}^{-1}\tilde{R}$ and $\tilde{B}$ respectively and ignoring all cross-price and quality effects. The difference between e_1 and e_2 is attributed to measurement error. In the absence of measurement error $\tilde{S}^{-1}\tilde{R} = \tilde{B}$ and $e_1 = e_2$. And in the absence of quality effects, cross-price effects and measurement error, $\tilde{S}^{-1}\tilde{R}$ divided by the budget share will equal $1 + e_1$.

In the majority of cases e_1 is very close or equal to e_2 implying a negligible effect of measurement error in the computation of the own-price elasticities. There are appreciable differences in the two values for sweet potatoes in the central-rural sector (Table 4.30); for beef in the eastern-urban sector (Table 4.31); for matoke in the northern rural sector (Table 4.32); for matoke and millet in the western-rural sector and for cassava and beans in urban-west (Table 4.33).

4.7 Price Elasticity Estimates

The relationship of $\tilde{B}$ to Ψ and Θ in equation 3.36, is used to calculate the matrix of price elasticities using equations 3.39 and 3.40. The resulting regional own- and cross-price elasticities for each food staple are shown in Tables 4.34 to 4.37. The rows of each table

Table 4.30: Cross-Cluster Variances and Covariances and Corrections: Central Region.

	$\tilde{R}$=cov(w, ln p)	$\tilde{S}$=var(ln p)	$\tilde{S}^{-1}\tilde{R}$	$\tilde{B}$	e_1	e_2
RURAL						
Matoke	0.0007	0.0501	-0.2651	-0.2991	-0.99	-1.02
Sweet Potatoes	0.0085	0.0325	0.4725	0.5975	-0.41	-0.34
Cassava	0.0072	0.0268	0.3263	0.3298	-0.22	-0.22
Maize	0.0040	0.0175	0.2699	0.2756	-0.54	-0.54
Millet	0.0000	0.0153	0.0039	0.0042	-0.09	-0.09
Beef	0.0038	0.0090	0.3599	0.3552	-0.43	-0.43
Beans	0.0018	0.0229	0.1094	0.1148	-0.42	-0.42
URBAN						
Matoke	0.0056	0.0287	-0.2097	-0.2867	-0.42	-0.45
Sweet Potatoes	0.0074	0.0230	-0.0055	-0.0127	-0.88	-0.89
Cassava	0.0050	0.0261	0.2270	0.2255	-0.55	-0.55
Maize	0.0038	0.0094	-0.0199	-0.0791	-0.70	-0.73
Millet	0.0019	0.0168	0.2111	0.2312	-0.27	-0.27
Beef	0.0031	0.0064	0.1467	0.1026	-0.28	-0.30
Beans	0.0025	0.0136	0.2516	0.2603	-0.31	-0.30

The covariances and variances are evaluated acroos cluster means. The ratio $\tilde{S}^{-1}\tilde{R}$ is that of the covariance to the variance. $\tilde{B}$ is the ratio of the covariance less $\tilde{\Omega}\tilde{N}^{-1}$ to the variance less $\tilde{\Gamma}\tilde{N}_{+}$. e_1 and e_2 are the own-price elasticities calculated ignoring all cross-price and quality effects using the ratio $\tilde{S}^{-1}\tilde{R}$ and ratio $\tilde{B}$.

Table 4.31: Cross-Cluster Variances and Covariances and Corrections: Eastern Region.

	$\tilde{R}$=cov(w, ln p)	$\tilde{S}$=var(ln p)	$\tilde{S}^{-1}\tilde{R}$	$\tilde{B}$	e_1	e_2
RURAL						
Matoke	0.0012	0.0396	-0.4386	-0.5835	-0.78	-0.86
Sweet Potatoes	0.0129	0.0389	-0.4092	-0.4593	-1.22	-1.29
Cassava	0.0112	0.0274	-0.3853	-0.4302	-0.19	-0.20
Maize	-0.0012	0.0166	-1.3140	-1.8898	-0.40	-0.46
Millet	0.0101	0.0158	-0.1421	-0.1513	-0.12	-0.12
Beef	0.0010	0.0047	0.4437	0.4603	-0.06	-0.06
Beans	0.0010	0.0176	-0.1264	-0.1308	-1.00	-1.01
URBAN						
Matoke	0.0110	0.0361	0.0364	0.0221	-0.17	-0.18
Sweet Potatoes	0.0048	0.0385	0.0209	0.0167	-0.19	-0.19
Cassava	0.0095	0.0204	-0.6635	-0.8057	-0.52	-0.57
Maize	0.0007	0.0090	-0.4944	-0.5426	-0.54	-0.56
Millet	0.0001	0.0131	-0.1224	-0.1406	-0.35	-0.36
Beef	0.0009	0.0026	-1.5933	2.8496	-0.33	-0.01
Beans	0.0036	0.0112	0.1212	0.1165	-0.46	-0.46

The covariances and variances are evaluated acroos cluster means. The ratio $\tilde{S}^{-1}\tilde{R}$ is that of the covariance to the variance. $\tilde{B}$ is the ratio of the covariance less $\tilde{\Omega}\tilde{N}^{-1}$ to the variance less $\tilde{\Gamma}\tilde{N}_{+}$. e_1 and e_2 are the own-price elasticities calculated ignoring all cross-price and quality effects using the ratio $\tilde{S}^{-1}\tilde{R}$ and ratio $\tilde{B}$.

Table 4.32: Cross-Cluster Variances and Covariances and Corrections: Northern Region.

	$\tilde{R}$=cov$(w, \ln p)$	$\tilde{S}$=var$(\ln p)$	$\tilde{S}^{-1}\tilde{R}$	$\tilde{B}$	e_1	e_2
RURAL						
Matoke	-0.0010	0.0305	-0.7173	1.9441	-0.32	0.13
Sweet Potatoes	0.0080	0.0410	-0.0397	-0.0632	-0.51	-0.52
Cassava	0.0098	0.0377	0.4417	0.4348	-0.20	-0.20
Maize	0.0021	0.0208	0.6884	0.8480	-0.08	-0.04
Millet	0.0041	0.0213	-0.6738	-0.9842	-0.33	-0.38
Beef	0.0024	0.0053	-0.1387	-0.1576	-0.12	-0.12
Beans	0.0088	0.0293	-0.0688	-0.0986	-0.58	-0.59
URBAN						
Matoke	0.0018	0.0226	0.0447	0.0445	-0.85	-0.85
Sweet Potatoes	0.0021	0.0179	0.1471	0.1511	-0.51	-0.51
Cassava	0.0074	0.0230	0.2595	0.2589	-0.34	-0.34
Maize	0.0056	0.0166	0.2011	0.1818	-0.40	-0.40
Millet	0.0004	0.0039	0.1721	0.1816	-0.10	-0.10
Beef	0.0019	0.0016	-0.3975	-0.4069	-0.19	-0.19
Beans	0.0026	0.0138	0.3838	0.3973	-0.07	-0.06

The covariances and variances are evaluated acroos cluster means. The ratio $\tilde{S}^{-1}\tilde{R}$ is that of the covariance to the variance. $\tilde{B}$ is the ratio of the covariance less $\tilde{\Omega}\tilde{N}^{-1}$ to the variance less $\tilde{\Gamma}\tilde{N}_{+}$. e_1 and e_2 are the own-price elasticities calculated ignoring all cross-price and quality effects using the ratio $\tilde{S}^{-1}\tilde{R}$ and ratio $\tilde{B}$.

Table 4.33: Cross-Cluster Variances and Covariances and Corrections: Western Region.

	$\tilde{R}$=cov$(w, \ln p)$	$\tilde{S}$=var$(\ln p)$	$\tilde{S}^{-1}\tilde{R}$	$\tilde{B}$	e_1	e_2
RURAL						
Matoke	0.0086	0.0496	-0.4751	-0.9069	-0.85	-1.05
Sweet Potatoes	0.0156	0.0501	0.1190	0.1986	-0.24	-0.21
Cassava	0.0013	0.0296	0.4618	0.6515	-0.13	-0.08
Maize	0.0020	0.0254	0.2589	0.5090	-0.37	-0.33
Millet	0.0037	0.0298	0.5636	1.0471	0.05	0.41
Beef	0.0020	0.0050	0.8581	0.8950	-0.54	-0.54
Beans	0.0053	0.0252	0.1737	0.1510	-0.29	-0.30
URBAN						
Matoke	0.0083	0.0290	-0.1511	-0.2009	-0.77	-0.80
Sweet Potatoes	0.0061	0.0416	0.1618	0.1658	-0.61	-0.60
Cassava	0.0038	0.0321	-0.4959	-0.0773	-1.39	-0.86
Maize	0.0049	0.0239	0.1443	0.1365	-0.77	-0.78
Millet	-0.0006	0.0138	-0.0576	-0.0584	-0.23	-0.23
Beef	0.0007	0.0024	0.2012	0.1990	-0.50	-0.50
Beans	0.0044	0.0227	0.3192	0.4166	-0.31	-0.18

The covariances and variances are evaluated acroos cluster means. The ratio $\tilde{S}^{-1}\tilde{R}$ is that of the covariance to the variance. $\tilde{B}$ is the ratio of the covariance less $\tilde{\Omega}\tilde{N}^{-1}$ to the variance less $\tilde{\Gamma}\tilde{N}_{+}$. e_1 and e_2 are the own-price elasticities calculated ignoring all cross-price and quality effects using the ratio $\tilde{S}^{-1}\tilde{R}$ and ratio $\tilde{B}$.

correspond to the food staple being affected by the change in price of the staple in the column. For example, the estimated cross-price elasticity of 0.41 in the second row of Table 4.34, refers to the percentage change in the demand for sweet potatoes following a 1% increase in the price of Matoke. A positive cross-price elasticity indicates the staples in question are substitutes while a negative one indicates they are complements. Staples that show no substitution or complementary relationship have a zero cross-price elasticity value. The standard errors, in parentheses, are derived according to equations 3.41 and 3.42.

4.7.1 Central Region

Table 4.34 shows all rural and urban own price elasticities in the central region were negative conforming to the law of demand. In rural-central only the matoke own-price elasticity was significant, and, at -1.02 rather high given that it has traditionally been regarded as a basic food here. Urban-central had no significant own-price elasticities.

There were only two significant and very elastic cross-price elasticities in rural-central and all were positive, indicating they were substitutes. They both involved an increase in the demand for millet due to price increases in sweet potatoes (1.73) and beef (1.53). In urban-central, a total of 16 cross-price elasticities turned up significant. Eleven of these were positive. Of particular interest was that showing a large increase in the demand for matoke following an increase in the price of sweet potatoes. Matoke is a preferred food in this region and if close substitutes such as sweet potatoes are no longer a bargain, the demand for matoke will tend to increase. The reverse of this cross-price is suspicious. It shows a significant decline in the demand of sweet potatoes following an increase in price for matoke. Since these two staples are known substitutes in the diet of central region households this scenario is unlikely. Equally suspicious is the complementary relationship between beef and maize. Maize is less preferred staple while beef is a luxury. We would expect a price increase on beef to result in increased consumption of maize not a decrease. The complementarity between cassava and beans is more believable on the other hand. Most consumption of cassava is accompanied with beans.

All urban cross-price elasticities were highly elastic with the exception of those relating to beans. Since most are positive this suggests wide substitutability amongst the staple foods.

Table 4.34: Estimates of Food Price Elasticities: Uganda, Central Region, 1993–94.

	Matoke	Sweet potatoes	Cassava	Maize	Millet	Beef	Beans
RURAL							
Matoke	[d]-1.02	-0.19	1.02	1.53	0.98	1.52	1.10
	(0.5)	(0.7)	(1.1)	(1.2)	(1.0)	(1.2)	(1.1)
Sweet potatoes	0.41	-0.34	0.75	1.53	-0.51	1.16	0.93
	(1.4)	(1.2)	(1.5)	(1.7)	(1.1)	(1.6)	(1.5)
Cassava	0.63	0.76	-0.22	1.84	1.16	0.97	0.96
	(1.1)	(1.2)	(1.0)	(1.3)	(1.2)	(1.2)	(1.2)
Maize	0.46	0.64	0.55	-0.54	0.54	0.32	0.37
	(1.3)	(1.3)	(1.3)	(1.2)	(1.3)	(1.3)	(1.3)
Millet	0.87	[d]1.73	0.95	0.88	-0.09	[d]1.53	0.73
	(0.7)	(0.7)	(0.7)	(0.7)	(0.7)	(0.7)	(0.7)
Beef	0.38	0.66	0.69	0.62	0.75	-0.43	0.76
	(1.1)	(1.2)	(1.2)	(1.2)	(1.2)	(1.0)	(1.2)
Beans	0.53	0.69	0.66	0.79	0.08	0.52	-0.42
	(1.2)	(1.3)	(1.3)	(1.3)	(1.2)	(1.2)	(1.2)
URBAN							
Matoke	-0.45	[d]55.50	11.97	[d]2.80	1.59	0.74	1.61
	(0.7)	(2.3)	(2.0)	(1.4)	(1.1)	(0.8)	(1.1)
Sweet potatoes	[d]-28.17	-0.89	1.07	[d]2.86	0.80	[d]3.16	[d]0.69
	(0.6)	(0.4)	(0.3)	(0.4)	(0.3)	(0.4)	(0.3)
Cassava	-2.86	0.44	-0.55	[d]3.45	0.61	[d]4.04	0.59
	(1.8)	(0.4)	(0.5)	(0.7)	(0.4)	(0.7)	(0.4)
Maize	0.32	0.70	1.27	-0.73	[d]1.49	[d]-3.40	0.91
	(0.4)	(0.5)	(0.7)	(0.6)	(0.8)	(1.5)	(0.6)
Millet	0.73	0.81	0.83	0.79	-0.27	0.67	0.70
	(0.8)	(0.9)	(0.9)	(0.9)	(0.5)	(0.8)	(0.8)
Beef	0.79	0.07	-0.31	[d]4.49	0.99	-0.30	1.11
	(0.6)	(0.2)	(0.4)	(1.2)	(0.6)	(0.4)	(0.7)
Beans	[d]0.58	-0.06	[d]-0.41	[d]1.44	[d]0.74	[d]0.67	[d]-0.30
	(0.1)	(0.0)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)

[d] Statistical significance at 5% level.

4.7.2 Eastern Region

Price elasticity estimates for the eastern region are contained in Table 4.35. All own-price elasticities of eastern-urban and rural households are negative as expected but range rather widely. They seem to follow no clear pattern, but, on average, those of the rural households are higher. Only sweet potatoes in rural-east have a significant own-price elasticity. And at -1.29, it is rather high for a basic food. All rural price elasticities with respect to sweet potatoes are significant with the exception of the cross-price elasticity with beans.

The eastern region cross-price elasticities, except for a few cases, are positive indicating wide substitutability amongst all the food staples. Only 6 of these elasticities are significant in the rural sector. Five of these are between sweet potatoes and other foods. The result shows a pronounced preference for sweet potatoes with rising food prices with the exception of two peculiar cases; with respect to matoke, and with respect to maize. The urban sector had 7 very significant positive cross-price elasticities. Six of these relate to beef. An increase in the price of these staples leads to an increase in the consumption of beef. Maize has a high cross-price elasticity of 5.09 with respect to cassava. This means urban household will readily substitute maize consumption for cassava if the price of cassava goes up. Both these are relatively inferior foods.

4.7.3 Northern Region

Price elasticity estimates of the 7 food staples for the northern region are contained in Table 4.36. There were six significant price elasticities in both the urban and rural sectors. All these occur with respect to matoke which is not widely consumed by households in this region. The elasticities are positive and seem high given the low status given to matoke.

4.7.4 Western Region

The western region had the highest number of significant price elasticities.(see Table 4.37). Most of these occur in the urban region. An increase in the maize price leads to a decrease in the consumption of matoke but increases that of millet in the rural sector. This sounds entirely plausible since millet is a preferred food in this region. There is highly significant substitution of beef for cheaper foods (cassava, maize and beans) in the urban sector. All price elasticities with respect to sweet potatoes and cassava and beans are significant and large in most cases. The bean own-price elasticity is quite inelastic. Bean consumption will change less with an increase in price since it is often consumed in sauce in accompaniment to other foods. For this reason, it is one of the more basic staples.

Table 4.35: Estimates of Food Price Elasticities: Uganda, Eastern Region, 1993–94.

	Matoke	Sweet potatoes	Cassava	Maize	Millet	Beef	Beans
RURAL							
Matoke	-0.86	0.64	0.95	-0.46	0.21	-1.59	0.25
	(1.25)	(0.90)	(1.06)	(0.87)	(0.54)	(1.94)	(0.59)
Sweet potatoes	[d]-1.08	[d]-1.29	[d]1.17	[d]-9.55	[d]0.60	[d]7.42	-0.25
	(0.12)	(0.14)	(0.08)	(0.18)	(0.06)	(0.13)	(4801.86)
Cassava	0.81	0.81	-0.20	0.63	0.86	1.44	0.83
	(1.14)	(1.14)	(0.57)	(1.01)	(1.17)	(1.50)	(1.15)
Maize	0.72	0.55	0.77	-0.46	0.90	0.90	1.39
	(0.62)	(0.54)	(0.64)	(0.51)	(0.69)	(0.69)	(0.85)
Millet	0.79	0.87	0.96	2.90	-0.12	1.96	0.84
	(1.62)	(1.69)	(1.78)	(3.02)	(0.63)	(2.51)	(1.66)
Beef	0.90	0.80	0.89	0.83	0.99	-0.06	1.25
	(0.79)	(0.75)	(0.79)	(0.76)	(0.83)	(0.21)	(0.93)
Beans	-0.15	0.70	0.95	[d]11.80	0.83	1.89	-1.01
	(0.55)	(0.96)	(1.06)	(1.64)	(1.02)	(1.28)	(2.21)
URBAN							
Matoke	-0.18	1.19	0.20	1.23	0.76	3.84	1.80
	(0.62)	(1.39)	(0.62)	(1.41)	(1.16)	(2.07)	(1.63)
Sweet potatoes	0.93	-0.19	0.69	1.35	0.85	3.81	1.05
	(1.21)	(0.58)	(1.06)	(1.44)	(1.17)	(2.18)	(1.28)
Cassava	0.93	0.86	-0.57	4.18	0.78	-2.12	0.90
	(0.69)	(0.67)	(0.61)	(1.22)	(0.64)	(1.37)	(0.68)
Maize	0.67	0.85	[d]5.09	-0.56	0.80	-1.88	0.35
	(0.58)	(0.65)	(1.33)	(0.57)	(0.64)	(1.14)	(0.43)
Millet	0.79	0.81	0.64	0.82	-0.36	2.37	1.38
	(0.77)	(0.78)	(0.70)	(0.79)	(0.54)	(1.25)	(0.99)
Beef	[d]0.84	[d]0.93	[d]1.73	[d]1.05	[d]0.72	-0.01	[d]0.85
	(0.22)	(0.24)	(0.32)	(0.25)	(0.21)	(0.02)	(0.23)
Beans	0.54	0.54	0.54	0.54	0.54	0.53	-0.46
	(0.96)	(0.96)	(0.96)	(0.96)	(0.96)	(0.95)	(0.89)

[d] Statistical significance at 5% level.

Table 4.36: Estimates of Food Price Elasticities: Uganda, Northern Region, 1993–94.

	Matoke	Sweet potatoes	Cassava	Maize	Millet	Beef	Beans
RURAL							
Matoke	0.13	[d]0.94	[d]0.99	[d]1.11	[d]0.74	[d]0.89	[d]0.70
	(0.08)	(0.20)	(0.20)	(0.21)	(0.18)	(0.19)	(0.17)
Sweet potatoes	1.29	-0.52	1.95	1.45	-1.48	-1.92	1.60
	(1.40)	(1.14)	(1.62)	(1.46)	(2.35)	(3.06)	(1.51)
Cassava	0.06	0.39	-0.20	1.36	0.36	0.78	0.70
	(0.26)	(0.67)	(0.51)	(1.19)	(0.65)	(0.93)	(0.88)
Maize	0.73	0.76	1.07	-0.04	0.79	0.71	0.88
	(0.75)	(0.76)	(0.89)	(0.19)	(0.78)	(0.74)	(0.82)
Millet	0.71	0.86	0.81	0.89	-0.38	0.95	0.69
	(0.81)	(0.88)	(0.86)	(0.90)	(0.61)	(0.93)	(0.79)
Beef	0.70	0.64	0.96	1.07	0.90	-0.12	0.89
	(1.84)	(1.77)	(2.15)	(2.26)	(2.08)	(0.79)	(2.07)
Beans	0.15	0.50	0.63	0.74	0.63	0.51	-0.59
	(0.53)	(0.93)	(1.04)	(1.13)	(1.04)	(0.95)	(1.10)
URBAN							
Matoke	-0.85	3.41	4.21	0.46	1.54	0.35	2.71
	(3.68)	(3.13)	(3.24)	(1.75)	(2.63)	(1.57)	(3.00)
Sweet potatoes	0.61	-0.51	0.73	-1.06	0.36	0.33	0.63
	(0.45)	(0.44)	(0.48)	(0.67)	(0.35)	(0.33)	(0.45)
Cassava	0.83	0.82	-0.34	-0.39	-1.01	0.66	0.94
	(0.95)	(0.95)	(0.66)	(0.70)	(1.19)	(0.85)	(1.00)
Maize	0.63	1.05	0.82	-0.40	0.64	0.72	0.75
	(0.73)	(0.93)	(0.83)	(0.59)	(0.73)	(0.77)	(0.79)
Millet	0.96	1.07	1.38	1.06	-0.10	1.15	1.18
	(0.92)	(0.97)	(1.09)	(0.97)	(0.30)	(1.00)	(1.02)
Beef	0.93	0.91	1.00	-0.15	1.29	-0.19	0.99
	(0.92)	(0.91)	(0.95)	(0.38)	(1.07)	(0.43)	(0.95)
Beans	0.90	0.80	0.95	0.72	1.89	2.51	-0.06
	(1.31)	(1.24)	(1.34)	(1.19)	(1.77)	(1.95)	(0.37)

[d] Statistical significance at 5% level.

Table 4.37: Estimates of Food Price Elasticities: Uganda, Western Region, 1993–94.

	Matoke	Sweet potatoes	Cassava	Maize	Millet	Beef	Beans
RURAL							
Matoke	0.00	-0.08	1.20	[d]-0.47	-0.79	-0.62	-4.67
	(1.10)	(0.25)	(0.80)	(0.64)	(0.89)	(0.76)	(2.49)
Sweet potatoes	1.42	-0.21	2.07	4.26	1.15	1.19	-1.47
	(1.00)	(0.42)	(1.17)	(1.54)	(0.92)	(0.93)	(1.20)
Cassava	1.16	0.92	-0.08	-1.34	0.88	[d]7.42	-0.72
	(0.77)	(0.70)	(0.22)	(0.94)	(0.68)	(1.58)	(0.66)
Maize	0.76	0.54	0.65	-0.33	0.70	[d]1.00	[d]3.03
	(0.44)	(0.38)	(0.41)	(0.30)	(0.43)	(0.51)	(0.85)
Millet	[d]0.72	[d]1.48	[d]0.68	[d]1.96	0.41	0.53	[d]2.27
	(0.33)	(0.45)	(0.32)	(0.50)	(0.25)	(0.29)	(0.52)
Beef	-0.06	0.40	0.63	0.63	0.49	-0.54	0.17
	(0.14)	(0.37)	(0.46)	(0.45)	(0.40)	(0.44)	(0.24)
Beans	-0.35	-0.31	-0.87	-0.91	1.05	[d]3.04	-0.30
	(0.34)	(0.32)	(0.55)	(0.56)	(0.55)	(0.85)	(0.31)
URBAN							
Matoke	-0.80	0.45	[d]2.14	[d]-15.93	0.46	1.61	[d]6.08
	(1.07)	(0.62)	(1.08)	(1.76)	(0.62)	(0.99)	(1.34)
Sweet potatoes	[d]1.05	[d]-0.60	[d]1.91	[d]0.63	[d]0.69	[d]0.06	[d]13.40
	(0.30)	(0.30)	(0.37)	(0.25)	(0.26)	(0.09)	(0.53)
Cassava	[d]0.18	[d]2.07	[d]-0.86	[d]-0.56	[d]1.39	[d]0.63	[d]4.01
	(0.02)	(0.06)	(0.06)	(0.04)	(0.05)	(0.04)	(0.07)
Maize	3.67	0.63	-1.17	-0.78	[d]1.61	-0.13	-0.18
	(0.78)	(0.44)	(0.83)	(0.62)	(0.62)	(0.22)	(0.26)
Millet	0.82	0.49	0.37	-0.13	-0.23	0.81	0.92
	(1.38)	(1.07)	(0.92)	(0.56)	(0.74)	(1.37)	(1.45)
Beef	0.59	0.45	-0.51	0.57	0.51	-0.50	0.50
	(0.66)	(0.58)	(0.63)	(0.65)	(0.61)	(0.62)	(0.60)
Beans	[d]-0.32	[d]8.36	[d]0.14	[d]1.56	[d]0.44	[d]1.05	[d]-0.18
	(0.11)	(0.32)	(0.07)	(0.20)	(0.12)	(0.17)	(0.08)

[d] Statistical significance at 5% level.

CHAPTER 5
SUMMARY CONCLUSIONS AND POLICY RECOMMENDATIONS

5.1 Introduction

The main objective of this study was to estimate urban and rural household demand elasticities of major food staples in each of the four regions in Uganda from cross-sectional household consumption survey data using Deaton's analytical demand model. Secondary objectives of the study included giving a detailed description of the food economy in Uganda and reviewing current and past regional food consumption patterns. Data for this study were taken from a nationwide household survey (IHS) conducted in 1992–93.

5.2 Uganda's Food Economy

Greatly improved security and a buoyant liberalized economy fueled by increased production and trade in food has characterized Uganda's economy since 1987. Over this period, food crops have become the main cash earners for rural households who make up 89 percent of the population.

The consequences for this shift from traditional export crops have been (1) increased vulnerability of rural incomes to fluctuations in food prices (2) reduced food security as a result of liberalized food markets out-bidding low income households. Also,higher prices temp the poor to sell their harvests early to cater for more immediate needs.

The increase in food production has almost exclusively been expansion in cultivated area. Most of the foods produced remain non-tradable outside of the domestic market. Continued growth of food production is then mostly dependent on domestic demand. Growth in the food sector has slowed down more recently. The slow down is attributed to: completion of the reoccupation of the cultivated areas abandoned in the 1970s, the saturation of the domestic market for food, given income levels, and the slow growth in incomes in non-food sectors of the economy [26].

The dynamics of the food economy and the fact that most Ugandan households depend on it for their livelihood makes it imperative that we have a clear understanding of how it operates so as to adopt effective food policies catering to the different regional consumption patterns observed.

5.3 Current and Past Regional Food Consumption Patterns in Uganda

Descriptive analysis of food consumption patterns of Ugandan households show they have changed little in the last thirty years. They are still largely made up of starchy staples and account for as much as 67 percent of total monthly household expenditure (Table 4.1). Six major food staples still account for the largest percentage share of expenditure devoted to food, namely: matoke, sweet potatoes, cassava, maize, millet and beans. Rural households were found, on average, to have larger food budget shares than their urban counterparts in conformity to Engel's law. Rural households were also found to have larger household size but considerably smaller monthly household expenditures.

Average food prices appear to follow a definite pattern of highest in the central region followed by the east, the west and lowest in the north (Tables 4.4 and 4.5). Despite the relatively low prices in the north, the accompanying low household expenditures render these households vulnerable to seasonal food insecurity. Weather induced food insecurity has in the past years been compounded by civil strife in this region.

Table 4.6 shows there were wide price swings in food prices between the survey and harvest periods. The survey period coincided with land preparation and planting in the south, and with the end of the harvest period in the north, hence, much smaller price differentials (see crop calendar in Appendix B). Storage of food harvests are inadequate nationwide. Most foods are eaten fresh and only a negligible number of households are able to refrigerate their food stocks. This means that food stocks can only be maintained for a short period of time after harvest. That the western, and central regions and part of the eastern region are blessed with two raining seasons decreases their vulnerability to food insecurity. The north and north-east region are on the other hand faced with a mono-modal rainfall pattern and have a more difficult time maintaining food stocks from one year to another. The reduction of post-harvest losses through improved handling and storage methods could mitigate incidences of food insecurity. This would also bring some stability in food prices which would enable households with more modest incomes to supplement their food stocks with market purchases.

The increased vulnerability of the north and north-east in recent years has also been due to the erosion of the traditional safety net provided by cattle, cotton and the availability of reliable train services. Cattle are regarded as the poor man's bank account especially in the pastoral north-east. Further, oxen are a traditional source of farm labor. However, these regions suffered extensive and very severe cattle rustling in the late 1980s and early 1990s carried out by the Karimojong. It will take a while to rebuild their herds. Impoverished households can no longer count on selling a head or two to supplement their food needs and with a shortage of oxen the amount of land cultivated has been greatly reduced.

The cotton crop, once a major cash-crop, suffered a dramatic decline in importance and, hence, acreage since the peak days of the 1970s. Ginneries that were once manned by the expelled Asian community fell into disrepair over the years, government cotton support programs ceased to function, and farmers were paid little and late for their crop. Faced with these problems most cotton farmers gave up growing it. In the annual crop rotation, cotton was usually followed by millet. Farmers claimed this rotation apart from meeting both their food and cash needs resulted in higher millet yields. Perhaps the millet crop benefited from the well leveled, well drained and weed free plots vacated by cotton. In any case the decline in cotton also impacted millet such that its acreage also dropped. Farmers claimed millet no longer did well when it did not follow cotton in the rotation. Millet, once a major staple, was slowly supplanted by sorghum in importance. Its decline, unlike that of cotton, had a direct effect on the food security of these regions.

Train services starting in the central region and going through east to the north and north-west provided crucial transportation of food harvests and other merchandise from the hinterlands of these regions to markets as far away as Kampala. With the proceeds, farm households purchased farm inputs and met their other household needs. The breakdown of this service deprived a great number of households, especially those in famine prone north and north-east, of extra income and access to reasonably priced farm inputs.

Regional differences in consumption patterns showed up in the per capita consumption Table 4.3. The western region, now, as opposed to the central, is the biggest consumer of matoke. The central region has, traditionally, been the largest consumer of matoke. Cassava consumption has now taken a preeminent position among other staples and according to the Ministry of Agriculture, was the number one staple in Uganda in 1994. Its appeal is no doubt linked to the food security as it offers to households over a wide range of climates. Being an inferior, food its increased popularity suggests more widespread household poverty, a finding that flies counter to the acknowledged improvement in household incomes over the last 10 years. The discrepancy may perhaps be attributed to the fact that these benefits have been concentrated in a small section of households that nevertheless contribute most to the averaged figures.

Millet no longer figures prominently in the diets of north and northeast households while maize and beans have become important food staples, practically, countrywide. Beans and maize owe their appeal to their dual nature as food and cash crops and store easily. They also benefit from dependable demand from institutions such as schools and the army, and are also used by the World Food Program (WFP) to cater to refugees.

The main reason why food consumption patterns have changed little is because of stagnant and sometimes negative economic growth over much of the period from the mid–1960s to the mid–1980s. Changes in food consumption patterns can be primarily attributed to changes in household incomes and also to a rapid rate of urbanization. Uganda remains largely rural (over 90 percent) and has, hence, had its food consumption patterns little affected by urban pressure.

Over the past decade Uganda has enjoyed unprecedented economic growth recorded at an average annual growth rate of 6 percent by the World Bank. Although this has translated into modest increases in the per capita incomes of Ugandan households, much of it has been recovery of ground lost during the years of civil strife and economic stagnation. If the pace of economic growth is maintained, food consumption patterns will surely change as the rise in household incomes influences household food demand in the market place.

5.3.1 Regional Food Demand Elasticities and Demographic Effects

Deaton's methodology was used to estimate demand elasticities using basic quantity and expenditure survey data collected in the IHS survey of 1992–93. The choice of the methodology was based on its allowance for (1) cluster specific effects in demand patterns; (2) non-consumption of certain foods by some households; (3) the influence of quality in computed unit values; and (4) the allowance for measurement error in reported unit value and quantity data. All these factors are basic features of household food consumption in developing countries such as Uganda and constantly bedevil demand analysts. The model included the analysis of the effects of demographic factors on regional food demand.

5.3.2 Effects of Demographic Variables

The demographic factors that were examined included household size, education of the head of the household and age-sex ratio groupings.

Household size

The results showed that household size has no significant effect on either food budget shares or unit values in all regional rural and urban sectors– suggesting a lack of influence on the food demand patterns. This is a rather strange finding since barring household compositional effects, larger households are expected to allocate a larger share of their expenditure on food by reducing expenditure on less immediate needs. One would also expect a negative effect on the unit value with an increase in household size as they substitute quantity for quality.

We would expect an increase in the demand for dairy foods such as milk if the increase in household size was as result of new births. However, milk was not one of the foods considered here due to its limited consumption accounting for only 3 percent of monthly household expenditure in Uganda [25].

Education

Model results showed only a minimal effect of education of the head of the household on food demand. The effect appears to be more pronounced in making food quality choices compared to its effect on the allocation of expenditure on food. In a surprising twist, less educated heads of households (ED1) in the same rural or urban sector appear to have a more pronounced effect on budget allocation and food quality decisions than their more educated counterparts (ED2). Overall, urban households had smaller education coefficients.

Age and Sex

Age-sex ratio coefficients turned out to be rather small in magnitude and largely not significant. This findings suggest there is no one age-sex group that significantly influences household food demand. There is no overt change in household food consumption patterns dependent on the household composition. Indeed households in specific rural or urban sectors have, largely, similar diets that are not tailored to household composition.

5.3.3 Expenditure Elasticities

Expenditure elasticities estimated using Deaton's methodology were all of the correct sign, mostly significant and fell within limits of 0 and 1. This shows most households in Uganda will increase consumption of these basic staples following an increase per capita household expenditure (household income). On average the elasticities of rural households were larger than those for urban households. Rural estimates were positive and falling with regional increases in household expenditure levels. However, those for urban households were mixed and followed no set pattern. Coefficients for beef, universally a luxury food among Ugandan households, were conspicuously low while those for cassava, a least preferred food were, relatively, high. Pruedencio and Al-Hassan [22] found that the frequency of hunger and the frequency of cassava consumption continuously increases in general as the frequency of hunger increases. Uganda has experienced increased susceptibility to hunger (even though largely localized) in the past decade due to adverse weather and civil strife. This may explain the relatively high expenditure elasticities when compared to those of other foods. That this phenomenon is happening amidst improved per capita incomes suggests that income distribution may be highly skewed with a significant portion of the population not sharing in the gains made.

5.3.4 Price Elasticities

Except for one non-significant own-price coefficient for matoke in rural-north all other regional own-price estimates were negative as expected. Matoke is rarely eaten in the north and the positive coefficient estimate is probably incorrect. Only three own-price elasticities were significant. A good number of cross-price elasticities were significant, quite elastic and mostly positive showing plenty of substitution among the 7 basic staples.

5.4 Policy Implications and Recommendations

Developing countries such as Uganda that are predominantly agricultural face an ever present dilemma of whether food policy should be geared towards (1) ensuring higher real food prices so as to elicit improved production and incomes and reduce vulnerability of its population to food insecurity, or (2) by actively supporting indigent populations with such policies as restricting food price increases, subsidizing foods consumed by the poor or banning of food exports to boost domestic availability. While the Uganda food market can be regarded as free from active government regulation such that food prices are determined competitively there have been occasions such as in 1994 when government placed a ban on food exports. This happened at a time when the north-eastern region was experiencing severe food deficits while the central and western regions had surpluses. It is not clear if the ban policy resulted in any improvement in the food situation in the north-east but it is clear that in an effort to improve it, farmers with surpluses lost export revenue.

The results of expenditure and price elasticities obtained here, along with those showing how demographic factors and quality attributes affect the demand for staple foods in Uganda, can be used in the formulation of a coherent food policy for the country. In addition to providing understanding of consumption behavior of Ugandan households it can be used to provide a foundation for demand projections.

Knowing what will be consumed at given expenditure elasticities, we need only know the price elasticities to know how much of a shift in consumption will occur given a specific price change. This would be a useful addition to the country's Early Warning Famine System to enable timely intervention to alleviate food insecurity.

Caution

While using Deaton's methodology appears to address most of the problems inherent in using budget survey data to analyze food demand and is capable of providing plausible demand parameter estimates, the results here should be treated with caution.This dissertation, to my knowledge, provides the first comprehensive food demand analysis of Ugandan households. As a result there is little literature available for comparison to establish the robustness of the results obtained here.

There are very few consumer demand studies that have been conducted in Uganda, and, hence, our knowledge in this field is very limited. This study provides a good foundation for future research in this field.

5.4.1 Recommendations

The north-eastern region of Uganda suffers seasonal food deficits that have been exacerbated by the long-term consequences of civil strife in the area. There is an urgent need to address this food problem before it spirals out of hand. The results from this study do not appear to properly document the situation possibly because of the level of aggregation even at the regional rural and urban divisions or the nature of the data used. It would, hence, be useful to carry out a more targeted household budget survey with sufficient food security focus to elicit better information that can then be used to formulate food policies for this region.

The two household surveys conducted in 1989–90 (HBS) and 1992–93 (SDA/IHS) provided Uganda with valuable data part of which has been used in this study. There is, however, need to continue carrying out periodical national household consumption survey (albeit on a much smaller scale than the HBS and SDA due cost) to generate time series data that can be used in conjunction with household budget surveys to support the better understanding of consumption demand patterns in Ugandan households.

APPENDIX A
HOUSEHOLD SURVEY QUESTIONNAIRES

Table A.1: Household Consumption Expenditure Questionnaire

HOUSEHOLD CONSUMPTION EXPENDITURE
PART A: FOOD, BEVERAGES AND TOBACCO - PURCHASES AND/OR CONSUMPTION OUT OF HOME PRODUCED STOCKS AND FREE GIFTS OR COLLECTION

Item	Code	Unit of Qty (code)	Purchases					Other sources of the item			
			From .... To		During the last 30 days		By whom (ID. No.)	Consumed in the last 30 days			
								Home produced		Free collection/gifts	
			Qty.	Value	Qty.	Value		Qty.	Value	Qty.	Value

Table A.2: Household Demographics Questionnaire.

	HOUSEHOLD ROSTER AND CHARACTERISTICS(all persons)										
ID No.	Name	Sex	Age	Relation	Marital Status	Highest Educ. Level Attained	Usual Activity Status	Father Educ. Level	Mother Educ. Level	Father's Usual Activity	Mother's Usual Activity
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)

APPENDIX B
SOME FIGURES

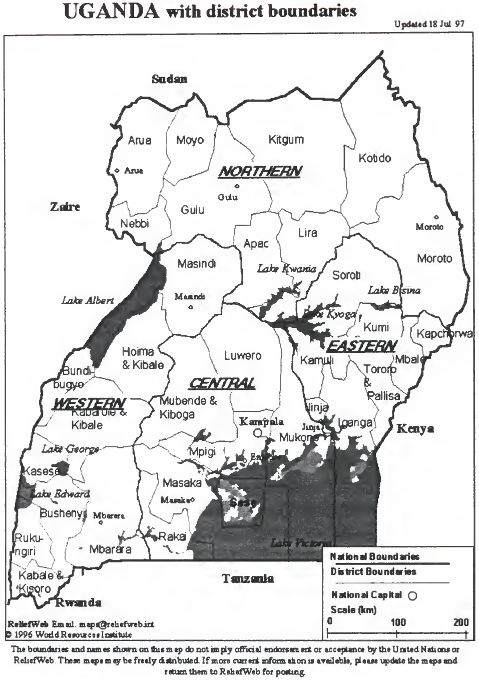

Figure B.1: A Map of Uganda Showing Regional and District Boundaries.

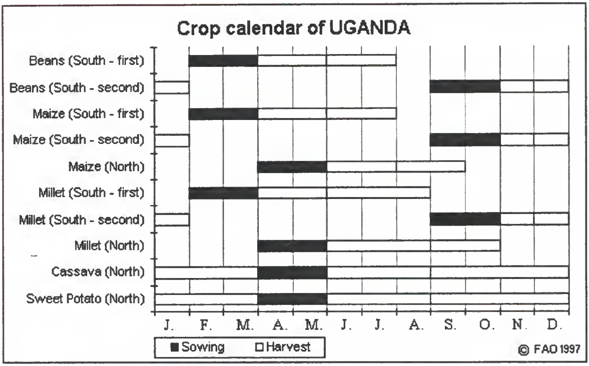

Figure B.2: Uganda's Crop Calendar

APPENDIX C

DISTRIBUTION OF HOUSEHOLD POPULATION BY AGE AND SEX IN UGANDA

Table C.1: Household Sex and Age Distribution: Central Region.

	Male		Female		Total	
Age group	No.	%	No.	%	No.	%
0-4	523,599	21.2	487,374	19.5	1,010,973	20.3
5-9	424,482	17.1	403,302	16.1	827,784	16.6
10-19	552,696	22.3	570,062	22.8	1,122,758	22.6
20-44	695,306	28.1	759,485	30.3	1,454,791	29.2
45-65	188,246	7.6	194,464	7.8	382,710	7.7
65+	92,132	3.7	86,636	3.5	178,768	3.6
All groups	2,476,461	100.0	2,501,323	100.0	4,977,784	100.0

Table C.2: Household Sex and Age Distribution: Eastern Region.

	Male		Female		Total	
Age group	No.	%	No.	%	No.	%
0-4	436,837	19.6	457,509	19.5	894,348	19.5
5-9	379,580	17.0	367,791	15.6	747,371	16.3
10-19	505,230	22.6	522,220	22.2	1,027,450	22.4
20-44	615,353	27.6	697,149	29.7	1,312,502	28.7
45-65	207,442	9.3	218,486	9.3	425,928	9.3
65+	87,076	3.9	86,772	3.7	173,848	3.8
All groups	2,231,518	100.0	2,349,927	100.0	4,581,445	100.0

Table C.3: Household Sex and Age Distribution: Northern Region.

	Male		Female		Total	
Age group	No.	%	No.	%	No.	%
0-4	359,439	19.8	337,970	17.5	697,409	18.6
5-9	366,779	20.1	376,803	19.5	743,582	19.8
10-19	452,410	24.9	401,236	20.7	853,646	22.7
20-44	471,058	25.9	593,339	30.6	1,064,397	28.3
45-65	131,383	7.2	183,399	9.5	314,782	8.4
65+	37,871	2.1	43,017	2.2	80,888	2.2
All groups	1,818,940	100.0	1,935,764	100	3,754,704	100.0

Table C.4: Household Sex and Age Distribution: WesternRegion.

	Male		Female		Total	
Age group	No.	%	No.	%	No.	%
0-4	456,713	20.7	457,050	20.5	913,763	20.6
5-9	390,629	17.8	343,351	15.4	733,980	16.6
10-19	489,133	22.2	500,216	22.5	989,349	22.4
20-44	612,105	27.8	682,336	30.7	1,294,441	29.2
45-65	167,966	7.6	176,835	8.0	344,801	7.8
65+	86,463	3.9	64,327	2.9	150,790	3.4
All groups	2,203,009	100.0	2,224,115	100.0	4,427,124	100.0

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BIOGRAPHICAL SKETCH

Peter Birungi Mijumbi was born on March 4, 1963, in Kampala, Uganda. He attended Makerere University from where he received a Bachelor of Science degree in Agriculture in 1986 with honors. Dr. Mijumbi then served as an Agricultural Economist in the Ministry of Agriculture at Kawanda Research Station until January 1989 when he was seconded for a Masters degree program in the United States.

Under the sponsorship of the USAID and the Uganda government, Dr. Mijumbi earned a Masters of Science degree in Agricultural Economics in May, 1992, at the University of Florida, Gainesville. In the same year he was admitted to the Ph.D. program under the sponsorship of the Rockefeller and Margoes Foundations.

For his dissertation research portion, Dr. Mijumbi returned to Uganda in November, 1994, where he conducted a household food security survey in the districts of Kumi and Pallisa. He also got data sets on household food consumption from the Ministry of Finance collected in the Integrated Household Survey 1992-93).

For his Ph.D. in Agricultural Economics Dr. Mijumbi specialized in the fields of International Trade and Development Economics. He hopes to apply the knowledge gained from both his masters and Ph.D. programs to the problems facing agricultural development in Uganda today.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Thomas H Spreen

Thomas H. Spreen, Chair
Professor of Food and
Resource Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Robert D. Emerson
Professor of Food and
Resource Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Max R. Langham

Max R. Langham
Professor of Food and
Resource Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

James L. Seale Jr.
Professor of Food and
Resource Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

William A. Bomberger

William A. Bomberger
Associate Professor of Economics

This dissertation was submitted to the Graduate Faculty of the College of Agricultural and Life Sciences and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

August, 2000

E. Jane Luzar

Dean, College of Agricultural and Life Sciences

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